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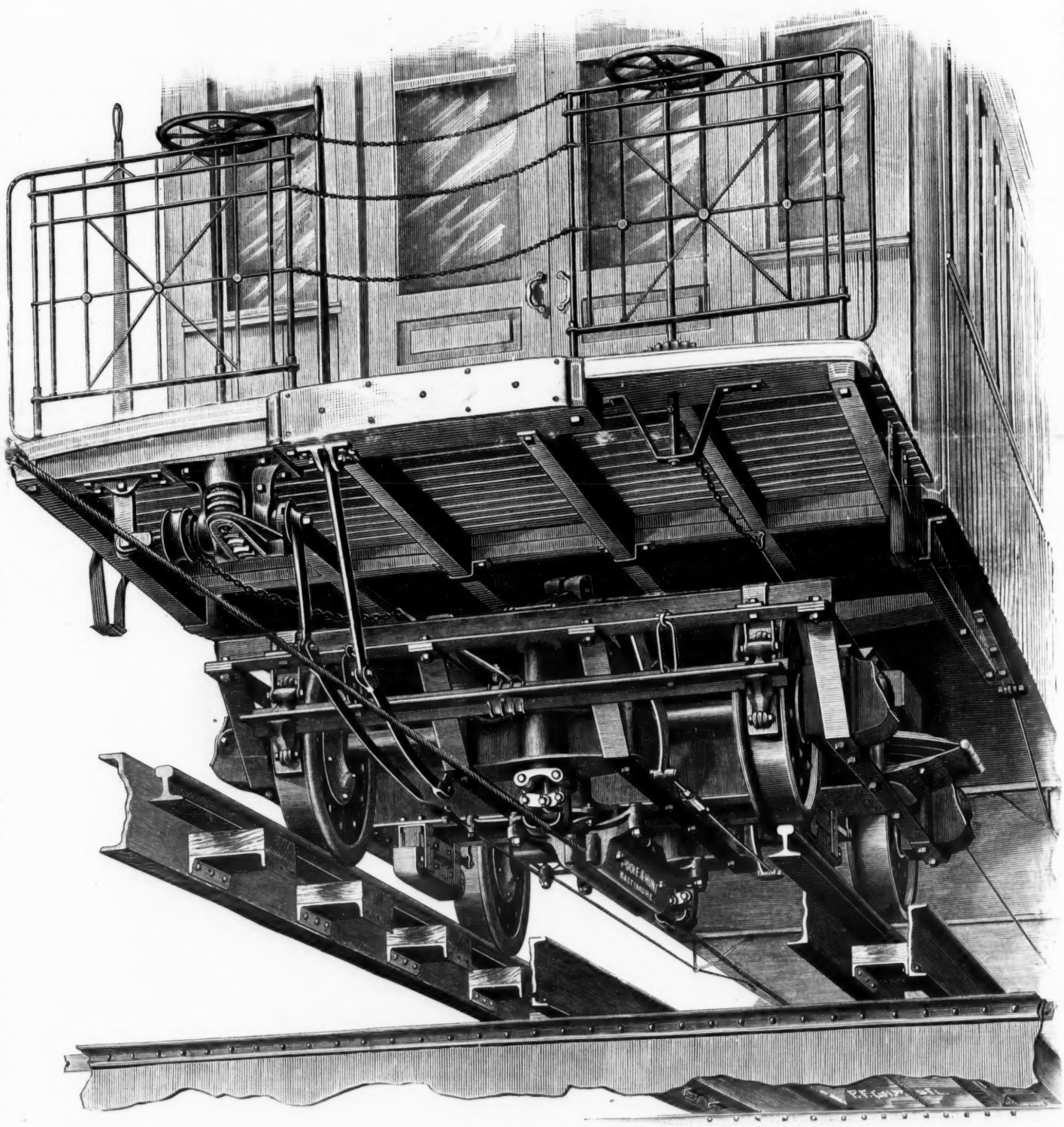
Mechanical Arrangements of the North Hudson County Cable Railway.

This road extends from Hoboken to Jersey City Heights, a distance of a little more than one mile. The method of running curves consists of a series of double width and double groove pulleys for carrying the cable; also upright, wide-face grooved pulleys for guiding the cable around the curves. These radius pulleys are so placed that the cable, when in the grip, is held away from them, thus preventing danger of striking, and doing away with the necessity of pulleys hung in swinging frames, which can be pushed out of the way when the grip comes in contact with the swing frames.

The operation of these pulleys is fully illustrated by Fig. 5, page 2, and the position occupied by the cable is also there shown.

By means of a simple arrangement the cable lifter (Fig. 3) will take up the cable at any point on the road, except on curves of very short radius.

The grip, the action of which is illustrated by Fig. 1, is about 3 feet long and consists simply of two pieces of cast iron, between which the cable is pressed.



NORTH HUDSON COUNTY CABLE RAILWAY.

In starting the car, pressure is applied gradually until the car is about up to speed, then the grip is set up sufficiently to carry the car to the foot of the grade, when a final application of the hand-wheel makes sure that the grip-pressure on the cable will carry the car to the top of the grade without slip. The car, when starting from the stations, will get up to speed (which is 9¼ miles per hour) in about 1½ to 2 times the length of the car; and this is done without perceptible jar to car or passengers.

The grip and brake are both operated by a single hand-wheel, but the connections are so devised that it is impossible to connect with both grip and brake at the same time.

In Fig. 2, A is the lever to which the grip-bar D, Fig. 1, is connected. The chain from the brake is attached to the eye-bolt C, and is wound around the grooved pulley in the usual manner.

At D, a lever is connected, which projects through the platform of the car near the grip and brake hand-wheel. By operating this lever, either of the clutches B or E may be put in connection with the worm wheel F.

As seen at H, which shows the clutch in pulley G, both C and J are loose upon the shaft, and can not be moved until they are brought separately into gear with the worm wheel F.

At I, the nut and washer J are shown with the lever A removed. G is the worm on the upright rod which carries the hand-wheel by which brake and grip are worked. It will readily be seen from the engraving, how G is brought in contact with the wheel F.

As seen in Fig. 1, the grip consists of two heavy jaws, which are made of cast iron and cored out their whole length to receive the shoes I I, which receive all the wear from the cable and can be readily replaced by removing the bolts J J J J.

The grip jaws are dovetailed to the body of the grip; these dovetails are shown by G and H.

At both ends of the grip are levers similar to those shown at A, B and C, which last, is connected to E and A, through portions of the grip not shown.

As lever C is moved to the right by turning the hand-wheel on the brake and grip shaft, which is connected with D, as before shown, A is revolved upon its axis, the lever B is drawn downward and a similar lever, which is connected with the upper end of A and the point F, is drawn upward, thus closing the jaws I I, and grasping the cable with tremendous power. These levers act upon the well-known principle of the toggle or elbow-joint, exerting their greatest power as they approach the end of their movement. By reference to the large illustration, the arrangement of these details may be clearly seen.

The cable lifter is shown in Fig. 3. The cylinder F slides easily through a cast-iron bolster which is shown in the large engraving. Connections E E are short links, to which are attached levers and weights sufficient to partly balance the weight of the apparatus shown in Fig. 3. The lever seen to the right of the brake and grip hand-wheel, in the large engraving, is connected to rod A, which runs through the hollow cylinder F, and is connected to the jaws C C, as shown at B. The lever, previously mentioned, is held by the catch I, which is made fast to the platform by a lag screw. The hook H carries the lever. When it is desired to lift the cable, the lever is thrown backward out of catch I. This movement causes rod A to be depressed to its present position, opening the jaws C C as shown, and lowering cylinder F from B to the upper collar. The jaws C C are now on either side of the cable. When

the lever is thrown forward, rod *A* and links *B* are raised, the jaws *C C* close loosely around the cable. A further movement of the lever raises Fig. 3 bodily, carrying with it the cable. When the lever is caught by catch *G*, the collar *D* is in contact with the bolster as seen in large engraving, and the cable is in position to be caught by the grip. After the grip has been locked upon the cable the lever is thrown back to catch *H*, which opens the jaws of the lifter sufficient to allow the cable to drop when the grip is again unlocked.

The cable is carried upon light pulleys like *A*, Fig. 5. These are placed about 30 feet apart, except upon curves. The point *E* shows the relative position of cable and pulley when the grip is passing. At the curves a pulley is used in place of *A*, which has its face of double width, and carries two grooves instead of one.

At *G* is shown one of the guide pulleys used on the curves; *D* shows the position of the cable when the grip is passing, and also illustrates how the grip is enabled to pass these carrier and guide pulleys without striking them.

When upon a curve the cable lifter is unable to pick up the cable, but this is the only "dead point" possessed by this apparatus.

The objection may be raised that the lifter might come in contact with one of the carrier pulleys *A*, and thus be unable to get hold of the cable. But as there is a lifter at either end of the grip, and a grip at each end of the car, the distance between carrier pulleys being unequal to the distance between grips, it is impossible to place the car in such a position (upon a straight track) that two of the four cable lifters cannot get hold of the cable.

In addition to the regulation brake, a track brake is used, which is shown in Fig. 6. The guard rails of this road are made of iron. *E* is a set of wooden blocks connected to the lever shown, which fulcrums at *A*, on the pin B. This part of the brake is reversed in position, the guides *D D* sliding down over *E*, and pin *B* passing through hole *A*, the whole being bolted to the car just above the guard rail, and power applied by a lever through the link *C*. The wood *E* is forced down upon the guard rail, and forms a determined obstacle to the movement of the car.

The grip and cable lifts are made fast to the *truck frames*, instead of to the body of the car, thus preventing the possibility of a a heavy load springing the car, so the grip can get out of its proper position.

The cable, which is about 1½″ in diameter, is expected to and does stretch constantly. It began stretching when first placed upon the pulleys, and will stretch until it reaches a point at which the safe limit of elongation is reached. Then a new cable is in order, and the stretching process is repeated.

A new wire cable, like a new rope, is comparatively open in its strands. By continuous bending, the wires forming the strands are brought closer to each other; therefore, they can straighten a little, which gives greater length to the whole cable.

Bending the cable around pulleys must, of course, cause motion between all its strands. This motion will, in time, cause wear; the cable keeps getting smaller and smaller, and consequently grows longer. As will be seen above, stretching of the cable is a necessary condition of its use.

As the cable stretches, the slack is taken up by means of a large pulley hung upon an inclined plane. The pulley can be weighted to keep a constant tension upon the cable, regardless of expansion by heat or contraction by cold. The cable is received in the engine-house upon a 12-foot pulley, having six grooves cut in its face. The cable takes a half-turn around this pulley, and then passes to a similar pulley, around which it also takes a half-turn and then passes to the tightener.

As the cable stretches, and the tightening pulley reaches the lower end of its inclined track, the cable is given another half-turn around the driving pulleys, thus increasing its hold and securing greater driving power.

It has been found that the liberal use of tar upon the cable must be avoided when two or more turns have been taken around the driving pulleys. The tar, by collecting upon the first groove of the receiving pulley, soon increases the diameter of the pulley at that point, and causes the cable to be slack during its return to the second driving pulley, and may cause the cable to slip off the driving pulleys.

A large part of the operating mechanism

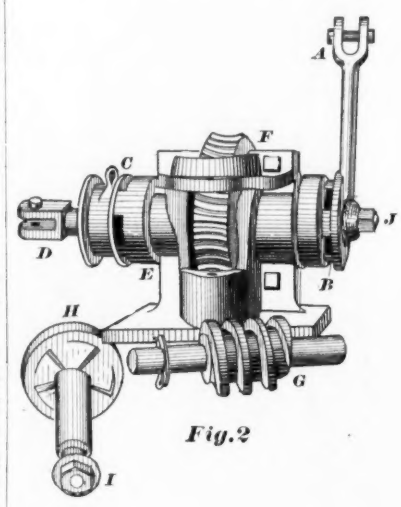


Fig.2

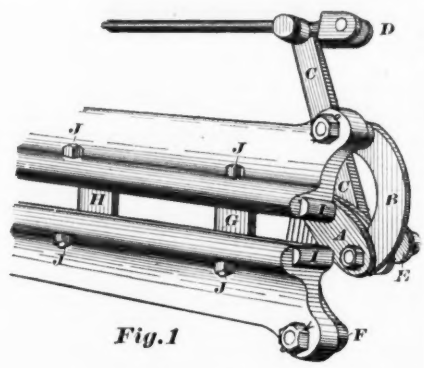


Fig.1

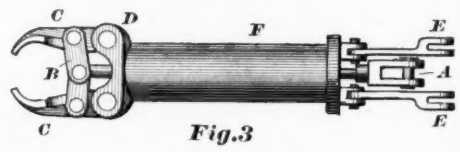


Fig.3

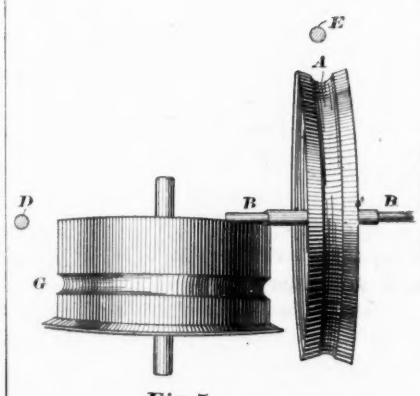


Fig.5

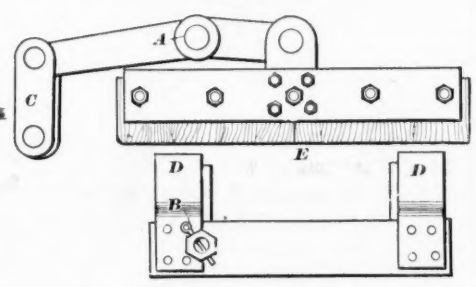


Fig.6

DETAILS OF CABLE RAILROAD MACHINERY.—See Page 1.

was made by Poole & Hunt, Baltimore, Md. The grip is the invention of J. J. Endres, of New York, who was the engineer in charge of the construction.

The Panama Canal.

A correspondent of an English paper, the *Globe*, writes under date of January 1, as follows of this enterprise:

"During a detention of a few days on the isthmus, while *en route* from London to Lima, I have had occasion to see some of the canal work and to talk with many of the employes, and with residents on the isthmus, and I am not surprised to find that very few people on this isthmus believe in the completion of the canal by the French. The work done amounts to only 10 per cent. of the whole, and over £12,500,000 has already been spent. There has been no practical system of management, and the waste and corruption have been terrible. The only work that has so far been done is that of Slavin Brothers, American contractors, who have several powerful dredges at work between Colon and Gatun. All over the rest of the line there are only a few scratches. Almost all I have conversed with (even canal men) predict that 'the bottom will soon fall out,' as the company is short of funds, and M. de Lesseps cannot raise more until he can explain where the £12,000,000 has gone. Workmen by the thousand have been discharged, and both termini, especially Colon, are now overcrowded with idle laborers, and you may expect trouble at any moment. The present Director-General (M. Varilla) has commenced to cut down salaries and other expenses, and to reduce the force, but I am very much afraid that it is too late. To complete the canal will cost £60,000,000 more, and it will then be too costly to pay. The Chagres river is a stumbling-block to the engineer corps of the Canal Company, and the question as to how they are to control it, will be the hardest nut they have to crack. They purchased the Panama Railway from the Americans, and on it have all American employes. The railway does an enormous freight and passenger business, but has no check or system of checking on the business of the road, and is greatly robbed by employes. You can do a great service to the English public if you warn them to let the Canal loan alone. The crash must soon come when this great project of the 19th century will cause a terrible financial crisis in France. Probably M. de Lesseps may come out to visit the work this spring, but the sight he will see and the realization that his 'canal' is a failure will, I think, have a sad effect on him. It will be hard lines for the poor peasantry of France when the bubble bursts. I hope none of our people will lose in it."

A recent English invention is a combination potato-chipping and pie-moulding machine. This invention ought to be supplemented with a cast-iron man to eat the pies.

Natural Gas Supply.

In a recent lecture at Columbia College, Charles A. Ashburner, geologist in charge second geological survey of Pennsylvania, a historical statement was presented relating to petroleum and natural gas.

In the course of the lecture, it was stated that, while the supply of petroleum might be considered practically inexhaustible, by present methods of obtaining the oil, but about one-tenth of the quantity existing in any given locality, or sand bed, could be brought to the surface of the earth.

Mr. Ashburner considers the natural gas supply to be closely identified with and coming from the same source as petroleum, but not relating to the coal deposits, except indirectly. He also stated that natural gas and petroleum were undoubtedly produced by animal and vegetable deposits upon the bottom of ocean areas which have long since been drained or upheaved, so that they form the present oil-bearing areas.

The supply of natural gas was, in the estimation of the lecturer, limited, and the day would surely come when the supply would fail, and the great benefit which the mechanical world is to derive from natural gas is not in its present use (which he stated, replaced the consumption of 18,000 pounds of coal daily in Pittsburgh, Pa., alone), but in teaching coal consumers the value of gaseous fuel and rendering its adoption certain and easy.

We gather from the speaker's statements, although not directly to that effect, that, as the natural gas supply fails, manufacturers who are using gas will gradually put in gas-works of their own, and thenceforth they will transform solid fuel into gaseous, and use it in that form.

Kelly & Groves' Adjustable Reamers.

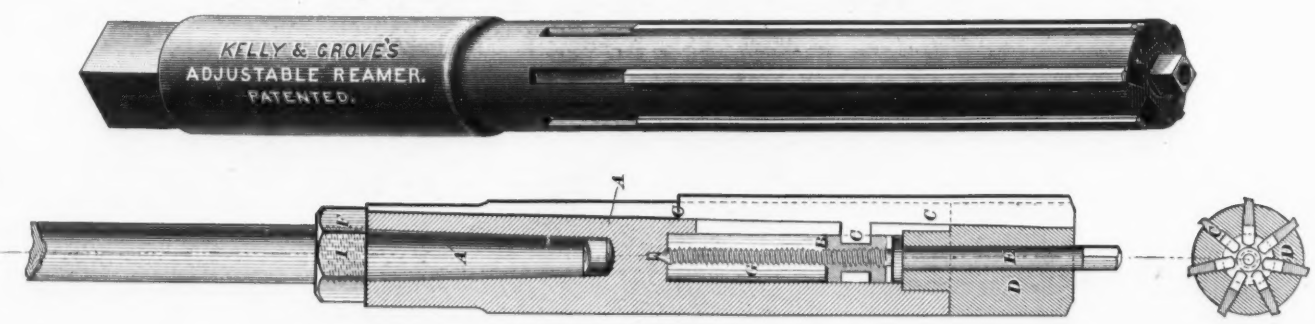
The shank or body of this reamer is made of steel. The cutters vary in number according to the size of the reamer, and in all cases the number is uneven. The cutters are dovetailed, and fitted into longitudinal groves, the bottoms of which form inclined planes with the axis of the reamer.

A part of the reamer is bored to receive a follower, or flanged nut, which is threaded, to admit a screw of fine pitch. A part of the cutter inwardly projects, and fits snugly the groove in the nut.

The nut is kept from turning by a pin; hence it will be seen that, by turning the screw, the cutters will move simultaneously, and the size of the reamer will be increased or diminished, as desired, and the cyndrical form of the reamer will be preserved, a thing impossible in reamers whose cutters are set up singly by hand, unless the reamers are ground after adjustment.

The idea of the invention is to supply convenient means to compensate for wear, although one tool may be used for different sizes: For instance, a 1½ inch reamer will ream a 1¾ inch hole, and a 2 inch reamer will work up to 2⅜ inches. The larger the size, the greater the expansion.

A glance at the accompanying engraving will fully explain the construction.



ADJUSTABLE REAMER.

A, designates the shell or body of a reamer, which has in its upper end, a cavity or socket, whereby it may be secured upon a collett, and may be used on a lathe or drill press. *B* is a follower or flanged nut, which fits snugly into cavity *G*. *E* is a screw for moving the cutters *C*. *D* is a cap and part of the body *A*, and keeps screw *E* from axial movement. *F* is nut for backing out collett.

These reamers are made from ½ inch in diameter and upward, for both hand and machine use.

The inventors are Kelly & Groves, 212 Park avenue, Brooklyn, N. Y.

The Milling Machine—Its Construction and Uses.

BY JOHN J. GRANT.

SECOND SERIES—FIRST PAPER.

THE CONSTRUCTION OF THE MACHINE AND ITS USES.

In former articles on the milling machine I confined myself to those most in use, such as the plain and universal machines. In this series I propose to describe other varieties and illustrate some of the different kinds of work that can be done on them. There are also a great variety of machines made originally for special purposes that can be used with slight alteration for other jobs.

In dropping the subject of the plain and universal machine, the reader must not think that the subject has received all the attention it deserves. The object in describing the different types of milling machines is to enable those who are novices in this branch of iron working to select the machine most suitable for their special line.

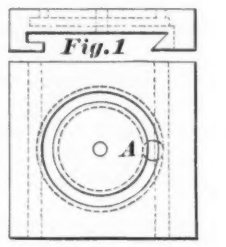
There are a great many special fixtures for milling that can be used independently, that should more properly be called portable milling machines, and in shops of any size would pay their first cost annually. These fixtures can be made for nearly every purpose, such as splining shafting when in position, cutting key ways in the hubs of large fly-wheels, facing off bosses and seats on all kinds of large castings, in fact, the variety is nearly inexhaustible, and a few such tools made of a universal character would save thousands of dollars in the purchase of large planers.

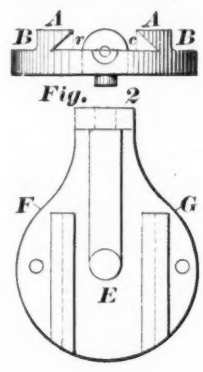
There are several makers of taps and dies who use the milling machine to cut the stock to proper lengths. When I suggested to the superintendent of one of these shops that he use the regular cutting-off machine, he said "they could cut off 33 per cent. more stock and the cutters were not as expensive as the regular cutting-off tools for the amount of work done." The screws in the original Horton chuck are cut with a milling cutter, and at a less expense than they can be cut with the regular engine lathe. A large share of the taps made by the Morse Twist Drill Co., are threaded with a milling cutter. The dies in Armstrong pipe stocks are finished in the same way, and are very perfect specimens of what can be done with a rotary cutter. I constructed a fixture for milling off the ends of lathe-beds after they were set up. It will do twice the work done on the planer, besides leaving it in better condition for finishing. My intention is, to take up each of these fixtures, describe and illustrate them with cuts so that every one may have the benefit of them.

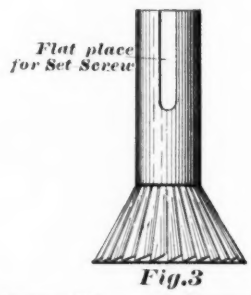
There has lately come into use a machine of the profiling machine class which I think will receive more attention as it becomes better known. This machine has been used in France for several years and I have seen some splendid specimens of work done with it. I have also before me a cut and description of a machine made in England, the spindle of which is made to adjust to any angle up to 45° out of perpendicular. This is a step in the right direction, but I think it does not go far enough. It should be adjustable to a horizontal position and made to fasten with a taper lock-pin at 90°, 45°, 35°, 30°, and vertical position. Bevel slides could then be milled with a plain cutter.

Irregular pieces can be finished by the use of the compound slides; face as well as periphery cutters can be used. Every machinist knows the bother of cutting circular T slots for bolt ways, such as are used in any machine having a rotary table or swivel head, as a planer tool head. These slots can be milled very quickly and perfectly on a vertical machine. A hole drilled at *A*, Fig. 1, will allow the cutter to pass through. The cutter should be of the straight-shank pattern as described in a previous article, and the work held in a vise or strapped to the revolving table, using a roughing and finishing cutter which should be fed by hand. I suppose planers will always be used, so the makers of such tools should take advantage of vertical milling machines, as a large amount of the work on a planer-head can be done with it at one-half the expense as compared with the planer.

The swivel head shown in Fig. 2, can be milled entire with one setting, as the back side







SWIVEL HEAD AND CUTTER.

is usually finished first on a lathe. The faces *A* and *B* are finished with the end or shank cutter; the depression *E*, where the slide fits, is finished both on the bottom and the angles, with a cutter shaped like Fig. 3. When the cutter is made special, it should be made as large as possible. If the machine be rigid, there will be no trouble to pass the cutter through a casting that is made with panel sides as shown by the dotted lines at *c r*, Fig. 2.

The cutter should be slightly rounded at the corners which will leave the work smooth and better to scrape. The edge from *F* to *G*, Fig. 2, can be finished around with a straight or shank cutter, using the rotary table; the other part of the edge can be worked around by using the compound slides. The work is left in better condition to finish than if done on a shaper or chipped by hand, as it is done in many shops at the present time. This style of machine is very useful in locomotive and tool shops, and the variety of work that can be done on it will naturally suggest itself to the mechanic. I have seen work, that in shops without such a machine, had to be put on a planer, then transferred to a heavy lathe and last, an experienced man would spend a day or more chipping and filing around an irregular edge that could be done in one quarter of the time and with cheaper help. In my next article I shall show a special machine or fixture for cutting key-ways in large fly-wheels, which will save its first cost in six months by any engine builder using fly-wheels too large to go under the slotter.

An American engineer returning from Mexico, writes us from Pachuca:

Although undoubtedly the Mexican machinist has much to learn from the American machinist, I must say I admire the ingenuity of the former, when I consider his lack of facilities. Most of the work is done, as they call it here, by "blood power." Coal throughout Mexico costs from $16 to $20 per ton, more frequently $20.

Automatic Grease Cup.

It is very generally claimed that with a properly prepared compound (usually called grease) and a cup constructed to suitably feed it, there is a saving over the use of oil, as ordinarily applied for lubricating journals. We present with this, engravings of a cup in elevation and section, that seems to fulfill the functions of a good feeder, which we believe will be admitted by those who examine its construction.

It will be observed that the wire, usually employed for feeding grease, is replaced by a twisted metal strip. This strip rests on the shaft the same as the wire ordinarily used. As is well understood in cups operating on this principle, any slight heating of the journal is communicated to the grease, by contact of the metal connection, causing the grease to flow. Now, with this fluted metallic strip, the flutes are full of grease in close proximity to the journal, so that an abundance of grease has but a small distance to flow to the journal. Furthermore, the single wire is, in the cup, in contact with only a small amount of the grease, and when this is melted away, the heat will not readily be communicated to the remaining grease in the cup. With the cup as made, the strips *C* come in contact with a large amount of surface, and but slight heat is required to melt all the grease in the cup.

The cover of these cups is fastened by an ingeniously-arranged spring, which permits of its being instantly removed for filling or inspection, and at the same time securely holds it against the possibility of jarring off, as on a locomotive, or in other places subjected to jar or rapid motion.

They may be used for feeding the ordinary grease sold for this purpose, or special grease furnished by the manufacturers.

These cups are manufactured in a variety of forms, for different purposes, by Main & Harris, 12 Coenties Slip, New York.

AUTOMATIC GREASE CUP.

Pattern-making.

BY F. W. BARROWS.

SIXTH PAPER.

PROPELLER WHEELS.

(FIRST PAPER.)

I don't propose to go into any scientific discussion of the merits of different-shaped blades, straight or increase pitch, or any of the other points, good or bad, real or fancied. I am going to try and tell how to construct a pattern for a given pitch and diameter. As the same general directions will apply to all wheels, let us first consider a plain straight pitch—say, a wheel 8′ diameter and 12′ pitch. By 12′ pitch I mean that the wheel would advance 12′ during one complete revolution if there was no slip. Imagine, if you can, a bolt 8′ in diameter, having a thread of so steep a pitch that it makes but one turn in 12′. Cut a segment out of this thread and you have the blade as stated. This bolt, if turned in an iron nut, would advance 12′ in one revolution, but in the water there is always more or less slip, as it is called, or lost motion, owing to the yielding of the water, which is the nut for the wheel.

We shall want a drawing first, showing the pitch, shape of hub and thickness of blade at different points, although the thickness can only be located positively at all points when the outline of blade is known. Some designers wait until the face of wheel is worked off before laying out the shape of blade; so it is customary to allow plenty of stuff on the back side, that the thickness of bucket may be so located, after the outline is given, as to give the best backing qualities consistent with strength.

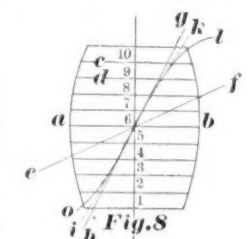


Fig.8

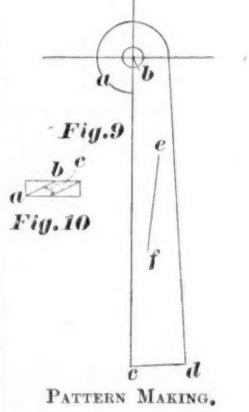


Fig.9

Fig.10

PATTERN MAKING.

Let the curved lines *a b*, Fig. 8, represent the full size and shape of hub desired, and the parallel horizontal lines *c d* show the course of pattern; then draw lines showing the pitch at different points. The line *e f* gives the pitch at extreme length of blades *g h* at the point where the fillet between blade and hub begins. You may draw as many more between these two points as you think necessary, or as the shape of the blades requires. This is not necessary for a straight pitch, as it can be taken from any point.

Now get a piece of stuff for a templet, and dress to a parallel thickness equal to the thickness of courses in pattern. Having determined the center point (*b*, Fig. 9), draw a circle, *a*, smaller than the hub, yet large enough to give sufficient strength around the hole for a spindle, shown by the small circle, *b*, used in moulding. Draw a radial line, *b c*; this is the face of wheel. Measure off on this line four feet from center, *b*, and cut off the end of templet to this length. Now set a bevel on the pitch at circumference of wheel, as shown by line *e f*, Fig. 8, and lay this off on end of templet, as at *a b*, Fig. 10. Then measure thickness required at this point, as *c*, and draw another line parallel with *a b*. This last line determines the width of stuff necessary at this point, as *c d*, Fig. 9. By the same operation we may find the width at any point, and thereby get the shape of back edge of templet, adding as much as you like to chop off again.

You may now cut up the stuff for one bucket, which is all that is usually made, as the moulder makes the two, three or four buckets, as the case may be, from this one pattern by swinging it on its spindle, and making as many flasks as wanted. You can count up the courses necessary on the drawing, and it is a good plan to have them numbered. The stuff can be cut pretty near the shape desired, which is the shape of templet, Fig. 9.

In cutting up the stuff, see that the grain runs *out towards* the face and point, as you will chop off the wheel from the hub towards the point, so the grain should run in the same direction as line *e f* on templet.

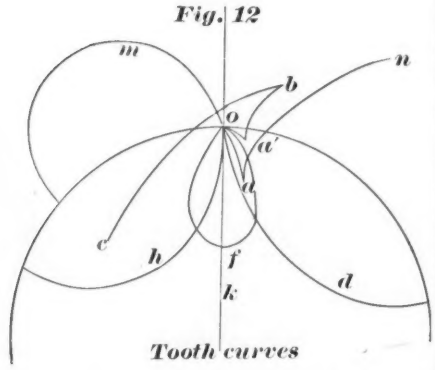
A class of engineers has been growing up who learn to manipulate the indicator and speculate on the peculiarities of the diagram merely as a sort of mechanical accomplishment. Mechanical knowledge acquired in this spirit is about as valueless to the world as was the mathematical knowledge of certain schools of ancient philosophers, who scorned to degrade science by applying it to promote useful arts.—*National Car and Locomotive Builder.*

The Normal Theory of the Gear Tooth Curve.

By George B. Grant, Boston.

SECOND PAPER.

Fig. 12



Tooth curves

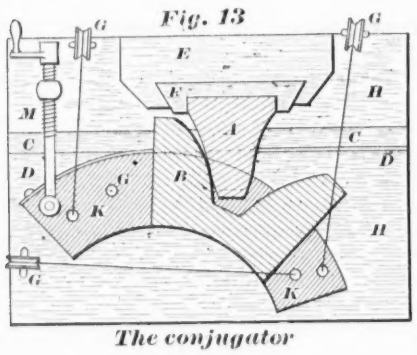
FORMS OF TOOTH-CURVES.

The face curve, commonly the external curve, is a lobe $O\,m$, Fig. 12, which generally returns to the pitch line, but the flank or internal curve may take a variety of shapes, generally a loop $O\,d$ or $O\,h$, but sometimes a straight diameter $O\,k$, a point at O, a loop $O\,f$, a cusp $O\,a\,n$, or a double cusp $O\,a'\,b\,c$.

When the flank is undercurved as at $O\,h$, a weak tooth is formed that should be avoided, and when it is nearly a point at O, it is subject to such excessive wear as to be impracticable.

When a cusp, $O\,a\,n$, or $O\,a'\,b\,c$ is formed, the action is mathematically perfect at all points, but practically is limited to the first branch from O to a. The contact changes, at the cusp from one side of the line to the other, and is therefore impracticable with solid teeth. The cusp always sets a limit to the addendum of the tooth that is working with it, for that tooth, as it continues in mathematical contact with the second branch, will interfere with and cut away the first branch.

Fig. 13



The conjugator

THE CONJUGATOR.

We have seen, Fig. 3, that any odontoid will form or "develop," an enveloping curve, that is also an odontoid and conjugate to it. The same process provides a simple and exact method for forming templets and cutter-shapers, in the application of the theory to practical purposes.

The conjugator, Fig. 13, is here the connecting link between theory and practice, for if the gear-cutter, or templet, must be shaped by hand and eye processes, theoretical precision would be lost, and the perfection of the finished product would depend, as usual, more on personal skill than on original principles.

A rack tooth is first formed on a steel-cutting tool A, which is fastened to a slide F that reciprocates vertically on a stand, E, on a plane table, H. A straight-edge, C, is fastened to the table in the position of the pitch line of the rack tooth, and an arc, K, representing the pitch line of the tooth to be formed, is rolled against it. A steel band, $D\,D$, keeps the arc firmly in position on the straight-edge, weights $G\;G\;G$ keep it in position on the table, and a screw, M, serves to slowly roll it.

A sheet metal blank, B, for a templet, a bar of steel for a cutter-shaper, or a complete gear blank for a complete gear wheel, is fastened to the arc K.

Now give the tool A a reciprocating motion, and slowly roll the blank B past it. An odontoid will be formed on the blank that is conjugate to the rack tooth, and, if it is formed of odontoids that are similar and symmetrical with respect to the pitch line C, all the odontoids made by it will be interchangeable.

The plane table, straight-edge and arc, slide and stand, can be accurately shaped by ordinary methods, but the shaping and placing of the tool A requires considerable skill.

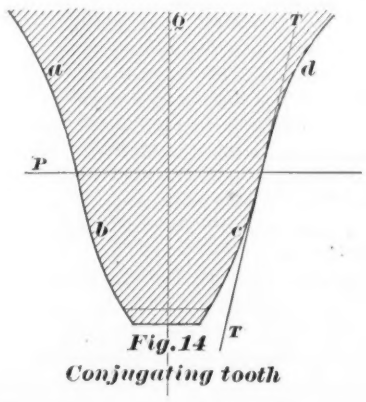


Fig. 14

Conjugating tooth

The chief requirement is that the rack tooth shall be formed of four equal odontoids a, b, c, d, Fig. 14, placed symmetrically with respect to the pitch line P, and reversed with respect to the line of centers Q. If the four curves are odontoids, all the formed curves will be odontoids, but the set will not be mutually interchangeable unless they are also equal to each other and properly placed on the pitch and center lines. It is also desirable, although not essential, that at their junction the curves should be tangent to the same straight line T.

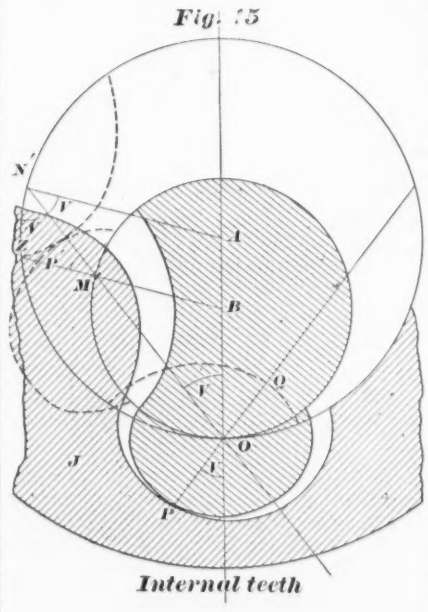
It is a matter of merely secondary practical importance that the originating curves should conform to some exact predetermined shape, for as long as they are odontoids the system will be perfect if formed by the conjugator. If they are cycloids, the cycloidal system will be formed; but, if the cycloidal outline is imperfectly followed, the system may still be mechanically perfect.

The tool A should be extended beyond the addendum line, as shown by dotted lines, so that the finished gear will have the usual clearance added to the working depth of the space.

A rack tooth is chosen for the originating form on account of its simplicity. If the straight-edge C is replaced by a circular arc, the flank curves of the tool A would not be like the face curves, and an interchangeable set could be obtained only by great skill in their formation.

If the stand E tips a little out of a right angle with the table H, the cutter-shaper B will be formed with a clearance or "relief," and its deviation from a correct form will be slight. If the blank B is held on a slide that will move radially to the arc K while the cut is being made, a relief will be given to the shaper without injury to its form.

Fig. 15



Internal teeth

INTERNAL GEARS.

We have seen, Fig. 7, that similar odontoids are conjugate and interchangeable, whether the pitch lines curve the same or opposite ways.

When the two lines curve the same way, as in Fig. 15, the smaller gear will work inside the larger, which is then an internal gear. The theory and its application are, in the main, the same as with external gears, the only prominent distinction being the direction of the curvature of one of the lines.

INTERFERENCE OF INTERNAL TEETH.

With internal teeth we must guard against interference, for the face of the pinion is likely to interfere with the face of the gear in a certain position P'.

When the teeth come in contact at P', their common normal $N'\,P'\,M'$ must pass through the pitch point O. Drawing $N'\,A$ and $M'\,B$, which will be parallel, we have $Z\,M'\,N' = A\,N'\,M'$, and the normal angles are equal. As the two odontoids are similar, and the normal angles are equal, the normals $P'\,N'$ and $P'\,M'$ are equal, and the point of contact bisects the chord $M'\,N'$.

The normal of contact $P\,O = P'\,N' = P'\,M'$ is therefore equal to c, the center distance $A\,B$, multiplied by the cosine of the normal angle V, or

$$\frac{P\,O}{\cos V} = c$$

and, if we draw the addendum at that value of $P\,O$, the teeth will clear each other, just as they would otherwise interfere. If we know the form of the odontoid in use, we can express $\cos V$ in terms of $P\,O$, and thence deduce the exact value of the latter that will let the teeth clear each other at the given center distance.

In case the face or the flank odontoids are not similar, the system is still interchangeable to the extent that any pinion will work in any gear, and in that case, the requirement to avoid interference is that the sum of the normals $P'\,N' + P\,M' = P\,O + O\,Q$ must not be greater than $M'\,N'$.

LIMITING DIAMETERS.

Knowing the minimum value of $\frac{P\,O}{\cos V}$ for any odontoid that may be in use, we can determine the least center distance between two gears that will work together, for that value of $\frac{P\,O}{\cos V}$ is the required least center distance.

DOUBLE CONTACT.

If

$$\frac{P\,O}{\cos V} + \frac{O\,Q}{\cos V}$$

is always equal to $2\,c$, the two faces will always be in driving contact, and, as the face of the pinion is also always in driving contact with the flank of the gear, we have a case of double contact as far as the truncation of the tooth will permit.

If $\frac{O\,Q}{\cos V}$ is given, we can assume a value for $\frac{P\,O}{\cos V}$ that will satisfy the requirement, so that it is always possible to obtain double contact by choosing special odontoids.

Double contact is a curious but not a very valuable feature of gear teeth.

Fig. 16 Fig. 17

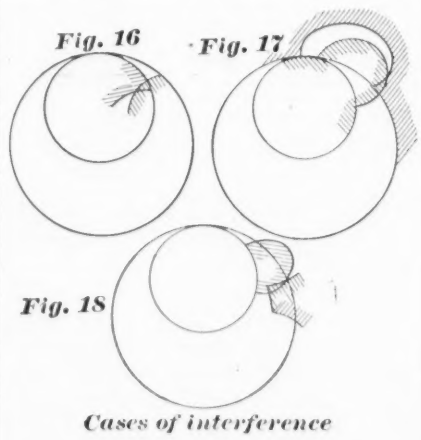


Fig. 18

Cases of interference

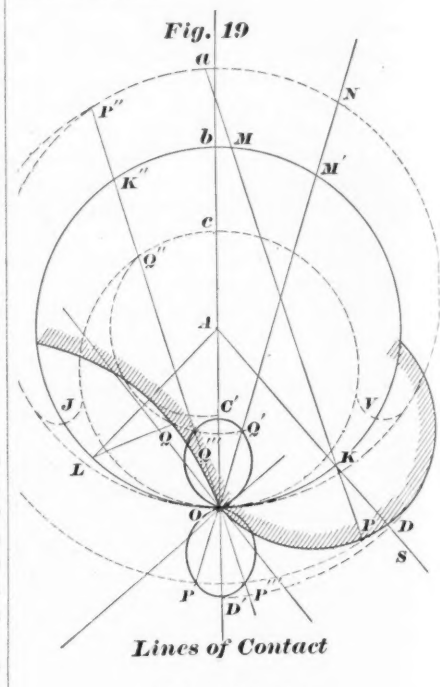
Internal gears may interfere from other causes, an odontoid from one crossing an odontoid from the other if the center distance is too small.

For example, if the tooth of the pinion of Fig. 16 is cut down to the pitch line to avoid the ordinary interference, they may still interfere as shown, the flank of the pinion interfering with the face of the gear. Similarly if the gear face is cut down, the pinion face may interfere with the gear flanks, as shown by Fig. 17.

The pinion face, when it cannot interfere with the gear face from the ordinary cause, may still cross it, as shown by Fig. 18.

The only remedy for interference is to shorten the addendum, to increase the center distance, or to use odontoids that curve quick enough to pass.

Fig. 19



Lines of Contact

LINE OF CONTACT.

The "line of contact" is the locus of the successive positions of the point of contact of an odontoid with the mating odontoid.

As each normal, $P\,K$, Fig. 19, comes to the pitch point O, the point of contact P locates one point, P', of the line of contact, and the four similar odontoids of the complete tooth form the complete line of contact $D'\,O\,C'$.

It generally takes the form of an hour-glass curve, is at right angles with the odontoid at O, and at right angles with the line of centers at D'.

As all normals, on all similar odontoids, have the same length for the same normal angle, it follows that a system of any number of similar odontoids has a single and common line of contact, which has equal face and flank lobes.

A definite line of contact is formed by any definite odontoid, but a given line of contact will not indicate a corresponding definite odontoid. All odontoids, similar or not, which have the same normal for the same normal angle, will form the same line of contact without regard to the value of the normal arc.

As the normal, $P\,K$, must intersect the pitch line a second time at M, there must be a secondary line of contact, the locus of the point P when M is at O.

If the odontoid intersects the pitch line at any angle except a right angle, the first normal will have its second intersection at V, so that the secondary line of contact begins at J and ends at V, where $O\,J = O\,V$.

The first intersection locates points P' and Q' on the primary line of contact, and the second intersection locates points P'' and Q'' on the secondary line of contact, where $P\,K = P'\,O = P''\,K''$, $L\,Q = O\,Q' = K'\,Q''$, $P\,Q' = P''\,Q' = P''\,Q'''$, and $b\,K'' = b\,M$. The secondary line will pass entirely around the pitch line, having apices at $a\,b = O\,D'$ and $b\,c = O\,C'$.

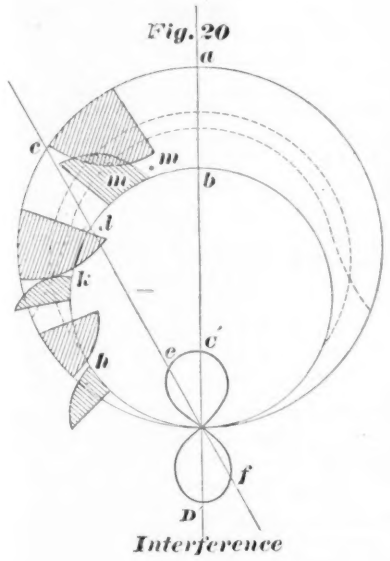
When the odontoid intersects the pitch line at a right angle, the first normal is a tangent to the pitch line at the pitch point, and having but one intersection, all the lines of contact will commence at that point.

The secondary line must have the same property as the primary as a locus of contact, but as it depends on the pitch line, it does not follow the same law with respect to similar odontoids.

The secondaries of two pitch lines in external contact cannot come together, but the face secondary of an internal gear can interfere with the face secondary of its pinion as in Fig. 20, and serve to indicate the state of the ordinary interference between the gears.

Where the lines separate, the teeth are clear of each other, *h;* where the lines cross or coincide there will be double driving contact between the teeth, *k;* and where one line passes inside the other after crossing it, there will be an interference, *m*, unless avoided by truncation.

Fig. 20

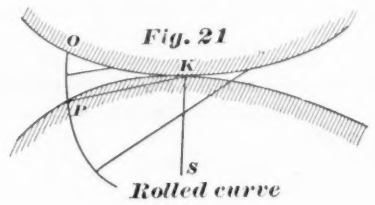


Interference

The crossing point of the two secondary lines of contact will determine the maximum addendum allowable on each gear face.

When, as is always possible by choosing the proper odontoids, the two secondaries coincide completely, or over any desired distance, there will be double contact. In all such cases we have $D'\ C' = a\ b$, or the sum of the diameters of the lines of contact must be equal to the difference of the pitch diameters. In fact, the same rule applies to all chords through O, $c\ d$ being always equal to $e\ f$ in cases of double contact.

Fig. 21



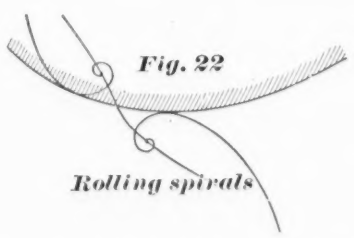
Rolled curve

ROLLED CURVES.

If a rolling curve or "roller," $P\ K$, be rolled on a pitch line, $O\ K$, a point, P, upon it will trace out a rolled curve, $O\ P$.

As the line $P\ K$, from the tracing point P to the point of contact K, is always rotating, for the instant, about K as a center, the curve $O\ P$ will always be at right angles to it at P, and it is, therefore, always a normal to the curve. As each one of the normals is separate from the preceding and following, and the normal intersections with the pitch line are consecutive, the rolled curve is a true odontoid. As the length of the normal $P\ K$, the normal angle $P\ K\ S$, and the normal arc $P\ K = O\ K$, are in no way dependent upon the curvature of the pitch line $O\ K$, they are the same for the same arc $O\ K$ on all curves, and therefore all odontoids traced on the same side of any number of different pitch-curves by the same point on the same roller are similar odontoids.

Fig. 22



Rolling spirals

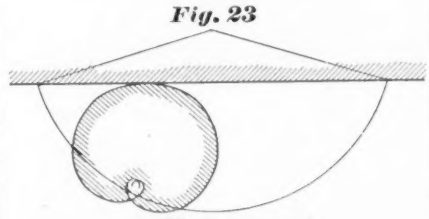
When the tracing point is any ordinary point on the roller, the curve traced will be at right angles to the pitch curve, but when it is the pole of a spiral it may cross at an angle. Fig. 22.

Although rolled curves and odontoids are identical, they cannot readily be considered the same, for the cycloid is the only odontoid worth noticing that can be conveniently handled in shape of a rolled curve.

The involute can be formed by rolling a logarithmic spiral on the pitch line, but that feature is a mere curiosity without practical value, while the circular segmental tooth of Fig. 23, a perfect and very simple odontoid, can be formed only by a roller that is a curious combination of polar spirals that can be discussed only by the use of the higher mathematics.

The properties of the odontoid can generally be more easily developed and clearly explained if it is considered as a special case of the enveloping curve, than if it is treated as a rolled curve, while, for practical purposes, the conjugator, founded on the normal theory, has the advantage of any device that is founded on the rolled curve theory.

Fig. 23



Rolled segment

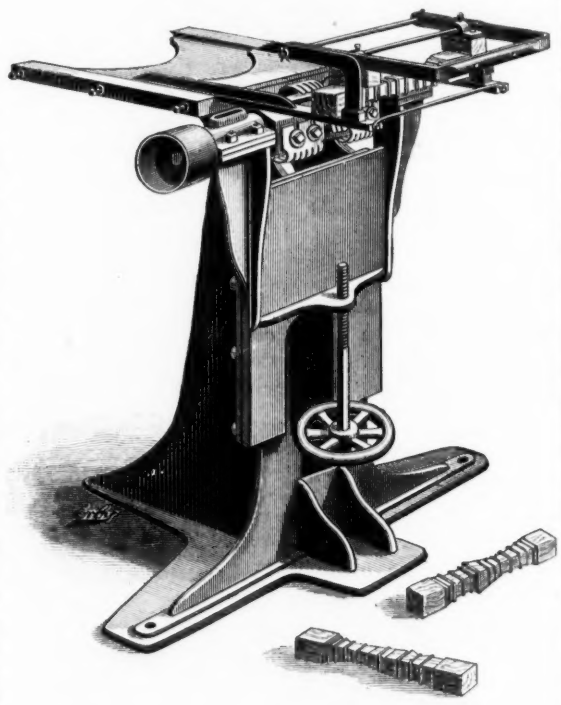
SPECIAL CASES, THE SEGMENT AND CYCLOID.

In another paper I purpose to explain the application of the normal theory to the segment, the involute form of the segment, the cycloid, and special forms of the odontoid.

Machine for Turning Irregular Shapes.

We illustrate with this a new machine for turning ornamental square legs for chairs, tables, lounges, stair balusters, etc., etc.; it will cut, it is said, *plinth* blocks or any irregular shapes across the grain of either hard or soft wood sufficiently smooth to admit of their being finished without sand-paper. The arrangement of knives is such that one set of six knives may be so placed on the cylinder that they will produce an entirely different pattern or style of work, and with two sets (twelve knives) it is possible to produce a large variety of different styles of work.

The work is held under a clamp in a sliding carriage, and passed over the cutting cylinder once for each side that it is desired to work. These machines are substantial, and intended for high speed. The cylinder shaft is of steel, $1\frac{3}{16}''$ in diameter, and runs in babbitt boxes each 6″ long, carried on top of a vertical slide, which is raised and lowered by means of a screw and hand-wheel shown in front. The cylinder is 5″ square, cast on the shaft, and is provided with T slots on four sides, which admit of changing the location of the knives to any desired location. The length of the head is governed by the kind of work it is to be used for. It is compact, occupying but 3′ × 4′ floor space. Manufactured by the Garden City Fan Company, Chicago, Ill.



MACHINE FOR TURNING IRREGULAR SHAPES.

The Theory of Gas Engines.

EXTRACTS FROM A TREATISE ENTITLED, "NOUVELLES RECHERCHES SUR LES CONDITIONS PRACTIQUES DE PLUS GRANDE UTILISATION DE LA CHALEUR ET EN GENERAL DE LA FORCE MOTRICE," BY M. BEAU DE ROCHAS.

When we examine what takes place in the combustion chamber of a gas-fired boiler, we are struck with the enormous volume which gases raised to a high temperature attain. If the combustion, on the other hand, takes place at constant volume, the dilation will be replaced by an equally considerable accession of elastic force; and the return to the original pressure, by means of expansion, will give precisely the same volume at the same temperature as if the heating had originally taken place under constant pressure. Combustible gas and fresh air are drawn in during a portion only of the stroke of the pistons of the gas cylinders. These cylinders thus perform the function of suction bellows by drawing in air for the supply of the cupola. Taps and valves regulate the access and proportions of the two descriptions of gas. The mixture is effected at low temperature, in conduits arranged for the purpose, and ignition is produced by known processes. The volumes of the gas and steam cylinders are arranged in accordance with the expenditure of the two fluids. Nevertheless, the steam cylinders ought to be of themselves, powerful enough to start the whole machine. The high temperature produced in the gas cylinder by direct combustion would be a cause of speedy destruction of the machine, if the walls were not maintained at a very low relative temperature. This low temperature would be an energetic cause of cooling in the gases, if it could not be met by other arrangements. But there will always be only a very slight drawback from direct utilization, if the heat thus dissipated gives return in producing steam. The gas cylinders, as well as their frames, will therefore be surrounded by water, and placed, by means of their exterior surfaces, in communication with the boiler in such a way as to insure the circulation of the water and the creation of steam. The elevation of temperature, even if very great, would not otherwise cause any sensible inconvenience with the walls maintained at a constant temperature. The variation in amount of suction answering in each case to the maximum of work being confined within narrow limits, the use of a slide will perfectly suffice to obtain the greatest variation in the yield of combustible gas. The arrangement, therefore, of the gas cylinders in the case in question can be made in the simplest manner with a common slide-valve, modifying, it is always understood, the forward and backward movements of it, to meet this particular requirement.

The arrangement before described appears certainly the simplest that could exist. It will, perhaps, be the only one applicable to locomotives. Then the increase of utilized power resulting from it will certainly be clear gain, and, without any doubt, out of proportion to the cost of setting up. But the true conditions of the best employment of the elastic force of gases—at least, its most important conditions—are not there observed; and simplicity is, perhaps, only acquired at the expense of utility. These conditions, in fact, are four in number—(1), the greatest possible cylinder space with the least possible exterior surface; (2), the greatest possible quickness of action; (3), the greatest possible expansion; and (4), the greatest possible pressure at the commencement of the expansion. The dispersive power of gases, so favorable to the use of boiler tubes, is evidently, on the contrary, an obstacle to the utilization of elastic force developed in the gaseous mass. Now, we have seen that in the case of boiler tubes, the efficiency—that is to say, the heat transmitted—was proportional to the diameter of the tubes. The loss would, therefore, be in inverse ratio to the diameter in the case of cylinders. But this is only applicable to cylinders of very small diameter, and the loss decreases, in reality, in a more rapid proportion than the diameter increases. Therefore, an arrangement which, for a given consumption of gas, will give cylinders of the greatest diameter will be that with which the greatest direct utilization of heat will correspond in this respect. We equally conclude from this that, as far as possible, we must only employ one gas cylinder in each separate machine. But dispersion depends also upon time. Cooling, then, will be as much greater, other things being equal, as the working pace is slower. Now, a more rapid working pace seems to imply, as a consequence, cylinders of a smaller volume; but this contradiction disappears when one reflects that the length of stroke is not necessarily related in an invariable manner to the cylinder volume for a given expenditure. In like manner as for the elastic force of steam, the utilization of the elastic force of gases requires that the expansion should be the most prolonged possible. In the arrangement above described, there is a maximum of expansion for each particular case. Thus the effect is necessarily limited. The advantage, therefore, rests with an arrangement which will permit of giving back to the machine that which we may call the free play of the expansion—that is, the power of expanding so far as we may think it convenient within the limits only imposed by the nature of things. Finally, the utilization of the elastic force of gases still depends on one element which is entirely their own, but which is, at bottom, intimately connected with the utility of prolonged expansion. This element is compression, which should be the greatest possible for the greatest effect. It can be easily seen that we are dealing here with heated expansion obtained after cold compression, which is a way of prolonging the expension in some sort inverse to that which consists in causing a vacuum—a way to which steam could not adapt itself, it being always understood that all compression inevitably causes an equivalent condensation in such a way that, even supposing steam to be combustible, instantaneous heating would be rendered impossible by reason of it. We can get as indefinite a utilization of the elastic force of gases by compressing them indefinitely before heating, as we can get an indefinite utilization of the elastic force of steam by indefinitely prolonging expansion. But practically we soon attain an impassable limit. It is that at which the raising of temperature due to previous compression brings about spontaneous ignition. In fact, in their continuing compression we shall only recover from the expansion, up to this same point, the work furnished by compression, less the loss occasioned by all useless action. There, then, is the limit imposed by the nature of things, and the final advantage in respect of utilization will rest with an arrangement which will permit of its attainment.

The question being thus propounded, the sole arrangement really practicable consists evidently in forthwith employing but one cylinder, so that it is the largest possible; and, further, in reducing the resisting movements of the gases to their absolute minimum. Then, and for the same side of the cylinder, we are naturally led to execute the following operations, in a period of four consecutive strokes: (1), suction during an entire stroke of the piston; (2), compression during the following stroke; (3), ignition at the dead point, and expansion during the third stroke; (4), forcing out of the burnt gases from the cylinder on the fourth and last return stroke. The same operations being reproduced on the other side of the cylinder in a similar number of strokes of the piston, there results a particular sort of single-acting machine, we might say of half-power, but which evidently satisfies the condition of largest possible

cylinder, and at the same time that condition (which is still more important) of previous compression. We see at the same time that the velocity of the piston is the greatest possible in relation to the diameter, since we do in a single stroke the work for which we should otherwise take two, and we evidently cannot do more. The temperature of the gas coming from the cupola is appreciably constant; that of the external air relatively varies only between narrow limits. Then the initial temperature of the mixture at the moment of the suction into the cylinder will also be appreciably constant. It will, therefore, be possible to determine the limit of compression at which ignition would become inevitable, and to arrange the machine accordingly. We shall thus constantly have the absolute maximum effect for each proportion of combustible material. We shall at the same time be freed from the intervention of electricity, for, the starting being effected by the action of the steam, the gases need never be introduced until the speed shall have become sufficient for ignition to be produced with certainty. In all cases compression will favor instantaneous ignition by helping complete mixture, and in raising the temperature. In fine, and with an initial temperature corresponding to a pressure of five to six atmospheres in the boiler, ignition will be spontaneously produced with a degree of compression reaching to about one-fourth of the original volume—at least, if we neglect the effect of dispersion. Then the pressure after ignition would attain barely thirty atmospheres, and, as we are dealing here with the case in which combustion is effected without excess of air, the pressure would necessarily be lower in all other cases. It is, therefore, probable that in many cases we can really attain the absolute limit of utilization.

To sum up, while manifestly lending itself, in the completest possible manner, to the utilization of elastic force developed in the gaseous mass by combustion under constant volume, the arrangement now in question is not less simple than the preceding one—at least, unless we consider as a complication the necessity (or rather the convenience) of employing in some cases, distribution by clack-valves. This distribution is generally the most advantageous, and there is nothing to prove that it is not applicable even to locomotives, and, above all, to the case in question.—*Engineering.*

Centers for Milling-machines, Planers and Shapers.

These centers, which we illustrate herewith, possess several features that appear designed to facilitate work. The spindle is hollow, tapered towards the front, to receive a $1\frac{1}{8}$ inch arbor. The face-plate has an adjustable clamp, constructed to firmly clamp any ordinarily-sized lathe dog, and at the same time to admit the dog to swivel for taper work.

It will be seen by the engraving that the back center is made of a solid bar (of tool steel). Two of these are furnished—one with a small center at one end, and a large one at the other; another with large and small female center at one end, and large male center at the other end.

The vertical adjustment is, by means of a pinion, working in a rack; the ends are reversible in the slide. It is locked firmly in position by clamp-bolts.

The spindle is provided with a clamping arrangement, which locks it firmly during cutting operations, thereby relieving the index-pin and dividing-plate from any strain.

These centers are designed especially for gear cutting, fluting rollers, taps, drills and reamers, milling key-seats in shafts, milling or planing nuts, lathe-boxes, etc., true with the hole, and wherever close dividing is required.

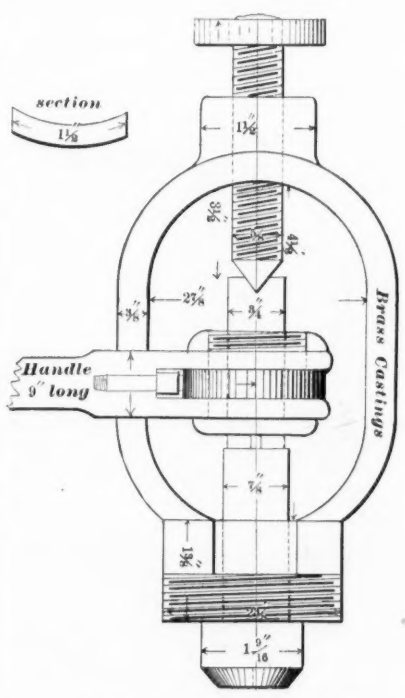
The Cincinnati Screw and Tap Company, Cincinnati, Ohio, are the manufacturers.

Electrotypes of machinery often wear out before the required number of copies have been printed. *Paper and Press* says: "Nickel-plated stereotypes, used in Germany, outlast ten common stereos." The same also applies to electros.

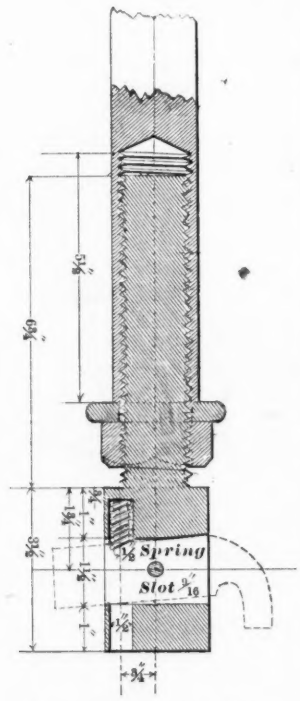
Pocket Oil Can.

The oil can which is shown herewith, is, we presume, designed more for use by bicyclists than by others. But it appears to be very convenient for use on sewing machines, or for those who have occasion to carry around a small supply of oil. The guard shown covering the end of the spout, so as to effectually prevent leakage of oil, is hinged as represented. The guard proper is held in place by a spring; by lifting on the end of the guard it is raised against the pressure of the spring, when it will swing clear, permitting the legitimate use of the oiler. A reverse operation closes it. The oiler is neatly gotten up, with spring sides, and is of convenient shape for carrying in the pocket. Made by the Overman Wheel Co., Boston, Mass.; Western agent, S. A. Smith, 59 S. Canal street, Chicago.

Manufacturers and sellers of railway material are noting a very general activity in their line of trade. It is apparent that railway companies must be large purchasers this year.



Hand Valve-reseating Tool.



Slotting Machine Tool.

LETTERS FROM PRACTICAL MEN.

Hand Valve-reseating Tool.

Editor American Machinist:

The accompanying sketch shows a tool which has proved very useful and efficient in reseating chest, globe and other valves that are fixtures on locomotive boilers and in other places.

It is the invention of C. Erickson, foreman of the Round-house on the first division of the C. B. & Q. R. R. The tool has been in use here for nearly twelve months. Mr. Erickson says: "They would not know how to do without them now;" there is a large number of locomotives on the division, and they use six or seven different sizes of checks and valves. A tool is made for each size of valve, and a rose reamer is also made for each size.

The various sizes vary from $\frac{3}{8}''$ to $1\frac{9}{16}''$, and are made to fit and screw into the valve after the cap is removed.

The sketch is about half size. The rose bit is worked by the small rachet as shown. The pressure screw is at the top of the device, and is fitted with a knurled wheel for feeding down the tools. This device does the work in a very short time, saves taking out the valves and breaking joints.

The device is not patented and Mr. Erickson finds pleasure in giving it for use by readers of the American Machinist.

Galesburg, Ill. J. B.

Slotting Machine Tool.

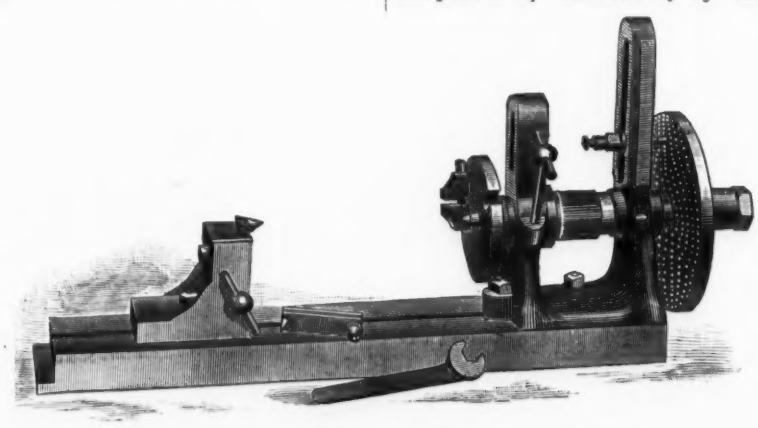
Editor American Machinist:

In the American Machinist of Nov. 7 and Dec. 12, 1885, were descriptions of tools for slotting-machines, which were favoraby commented upon. I send you with this a cut of one which has been in constant use in our shop for more than a year, and which I think possesses some points of excellence, not generally used in tools of this kind, combining simplicity with easy adjustment of the tools to the work to be done. As you will see from the section, our tool is a bar of machinery-steel, $1\frac{7}{8}''$ square, 24″ long. Into the end, we drilled and cut a fine thread, $5\frac{1}{2}''$ deep by $1\frac{1}{2}''$ diameter; into this we screwed a tool-post (see section), which is held in any desired position by means of check-nut and washer. By unscrewing the nut and turning the post, tools may be put in any position, without removing the bar from the machine. The tool-post is $2\frac{1}{4}''$ diameter by $3\frac{1}{2}''$ long, and slotted to take in $1\frac{1}{2}$ x $\frac{9}{16}''$ steel. The tools are held in the post by a taper-pin, put through center of slot. Tools to be an easy fit on pin, and are kept in proper position by a spiral spring, inserted in the post, on the back edge of tool. This spring is to allow proper relief in the upward stroke, and to bring the tool against the front upper and back lower edges of slot in tool-post, in the down or cutting stroke. We use tools of numerous shapes, and for slotting out driving boxes, or any kind of work which requires several different tools, it is very valuable, as tools can be changed quickly by simply driving out the taper-pin.

The idea of this post, capable of being put into any position, and still be held firm, originated with Russell Hawkes, foreman of the locomotive department of the Providence and Worcester Railroad. Mr. A. Griggs, superintendent of locomotive and car departments, fully endorsed the idea, and ordered this tool made.

It has been used for the past fifteen months, and has given entire satisfaction on a great variety of work, such as is usually found in a railroad repair shop.

William Foster.



Centers for Milling-machines, Planers and Shapers.

Slack System of Payment in Government Works.

Editor American Machinist:

At the present time, when so much is being said on the subject of weekly payment of employes, and when laws are seemingly about to be enacted making this compulsory, it may not be uninteresting to the readers of the American Machinist to hear of the system adopted at the U. S. Arsenal, Watertown, Mass.

The public would naturally infer that this place would be one of the first to adopt and sustain any measure which would be of so much benefit to the employes as that of weekly payments.

But in this, their conclusion would be at fault, as it would be in many other instances if they were to adopt that which would seem most natural concerning a place of this sort.

The system of payment here, if such it can be called, is this: The employes are *supposed* to be paid once a month, upon which day of the month they never know, until they receive their money. Usually it arrives between the first and tenth day. Twice within a year they have had to wait two or three weeks longer than the usual time, and once they received pay for two months' work in the same week.

To say that this irregularity and ofttimes delay is inconvenient, and that it sometimes brings distress upon some of the two hundred and fifty or three hundred machinists, blacksmiths and foundrymen employed there, would only be stating the truth in mild terms.

If the U. S. Government were hard pushed for money, or if it were some private firm which was financially embarrassed, this state of affairs might seem justifiable, but for a country with millions of dollars in the treasury is there any excuse? G.

Proportioning Journal Bearings.

Editor American Machinist:

In your issue of March 6th, Mr. Hoffman discusses the above subject in connection with engines, and gives a rule for determining size of crank-pins, based on his experience, to which I desire to take some exceptions.

This rule may have produced good results within the limits to which his experience has extended, but to one who does not know what those limits are, it would be of more value if the factor of work of friction was taken fully into account.

Every observing mechanic probably has noticed that by simply increasing the number of revolutions of a journal, other conditions remaining the same, the tendency to heating is increased, even when exceptional care has been taken to provide better lubrication in the case of the higher speed.

This fact can be explained by considering that however perfectly a journal may be lubricated or fitted, it yet has some amount of frictional resistance, and whatever this may be, it produces a proportional amount of heat. In slow moving journals, the large amount of conducting material and the time for conducting, in proportion to the amount of heat, is such that no sensible or injurious heat is detected. But if the journal speed be increased four times while the work done per revolution is the same, and the lubrication is equally good, there will be four times

the amount of heat produced by friction *in the same length of time*, which must be conducted away by the materials of the journal and bearing.

It then follows that with any proportion of bearing surface, and other conditions the same, a speed may be reached at which it will be impossible to operate even the most perfectly fitted and lubricated journal, without providing additional means of conducting away the heat.

One of the first considerations in a high-speed bearing would be to provide as good a conducting material as circumstances will permit, and then let the amount of bearing surface be proportioned to the work of friction in foot pounds per minute. In proportioning a crank-pin for high-speed engines, it seems to me important that the above facts be fully considered, and if they are it follows that Mr. Hoffman's proportions are of very limited application to high-speed engines. He also says, in speaking of engine main bearings, "Of course large and long bearings under high speeds, are the most unreliable." I do not think it fair to take this sentence to express fully his mature views in that matter, but I cannot let it pass without mention. Taking the case of a $5\frac{1}{2}''$ engine shaft I cannot see why he should say that long bearings are the most unreliable, unless he means that long bearings have actually less real bearing surface than short ones in the ca s which he had in mind when writing.

Again, if an engine shaft were small and the weight and work it transmitted were so great as to produce flexure of the shaft within the bearing, then it would be a positive benefit to make it larger in diameter, and thereby get additional bearing surface both by preventing flexure and increasing the surface area of the shaft. So it would seem but reasonable that a large and long bearing would stand a much better chance of having sufficient bearing surface than a short and small one would have. Increasing the diameter of the shaft beyond that necessary to attain the desired stiffness, would probably be of no benefit, from the fact that the increase of weight of the shaft would increase the friction enough to neutralize what would be saved by decreasing the pressure per square inch of surface, unless the pressure were great enough to force out the lubricant.

Increasing the diameter of a crank-pin will not greatly increase its tendency to heat, because if its diameter is double, the velocity of its surface is doubled, but this is almost neutralized by the fact that the pressure per square inch of surface is reduced just half. The main considerations therefore in determining the diameter of a crank-pin should be, first to give it sufficient transverse strength, and second, sufficient surface area so that the maximum pressure per square inch of surface may not exceed 14,000 pounds and which in marine engines seldom exceeds 800 pounds. In speaking of surface area of crank-pins, I mean the product of the diameter into length. The best way to increase the bearing surface of crank-pins would be to increase the length, were it not for the fact that in so doing it would increase the distance of center of connecting-rod from the main bearing. But I insist that whatever rule is used it must provide for increased conductivity of the bearing proportioned to the increased work of friction due to increase of speed, whether that is accomplished by increasing length of pin or by other means.

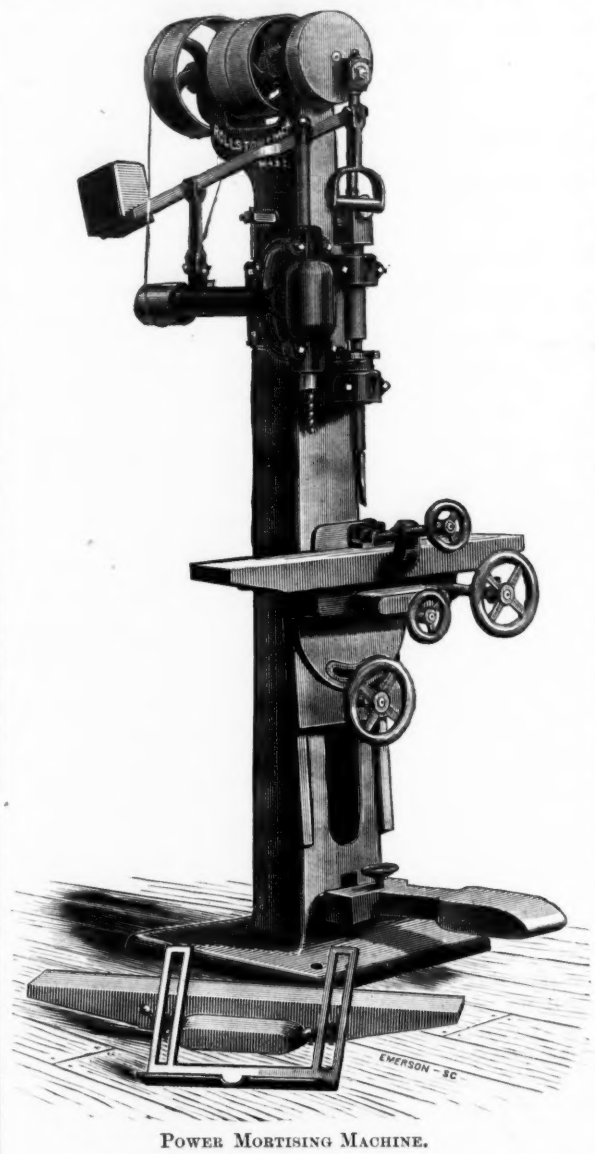
A. R.

Thinking Men—Fixing a Bad Break.

Editor American Machinist:

I wish to take exception to Professor Sweet's remarks in the AMERICAN MACHINIST of March 6, in which he indirectly presents the assertion that thinking men are the exception rather than the rule; my experience (a little more than eight years) tends directly opposite. Why, every job, repair work or new, requires the devising of some plan to do it. I speak of the shops around here where there are no modern machinists' tools.

To get the work done on time, you are compelled to use what there is at hand. If you sit down and say "I can't," someone takes your place that "will try." Self pride should keep a man from saying "I can't," without a very hard struggle. In a "jobbing shop" out here it is absolutely necessary for a



POWER MORTISING MACHINE.

"machinist" to think. For him not to think, is soon to become an unknown quantity, and in a very short time he will be found "helping" in the foundry, or a "roustabout" on the river.

The experience I spoke of is only one of the many "schemes" devised by the writer, who claims to be no exception unless it be that he is slower than his neighbor.

I was sent out about forty miles (this is the nearest point to a machine shop) on receipt of a telegram worded as follows: "engine in bad condition, send man to repair at once." I reached the place at 9.30 P. M., was met by the owner with "Come along, young man, we want this thing fixed, we must run to-morrow by noon at all hazards; have got a contract not quite filled; if not completed on time will loose the whole order." What I found coupled with the above was a "stunner." The piston-rod was bent, the piston head and front cylinder head were a pile of scrap iron. I stood surveying the pile when Mr. Owner reminded me that he "*must* run by noon to-morrow." I asked would it do if it were in a condition to run ten hours?

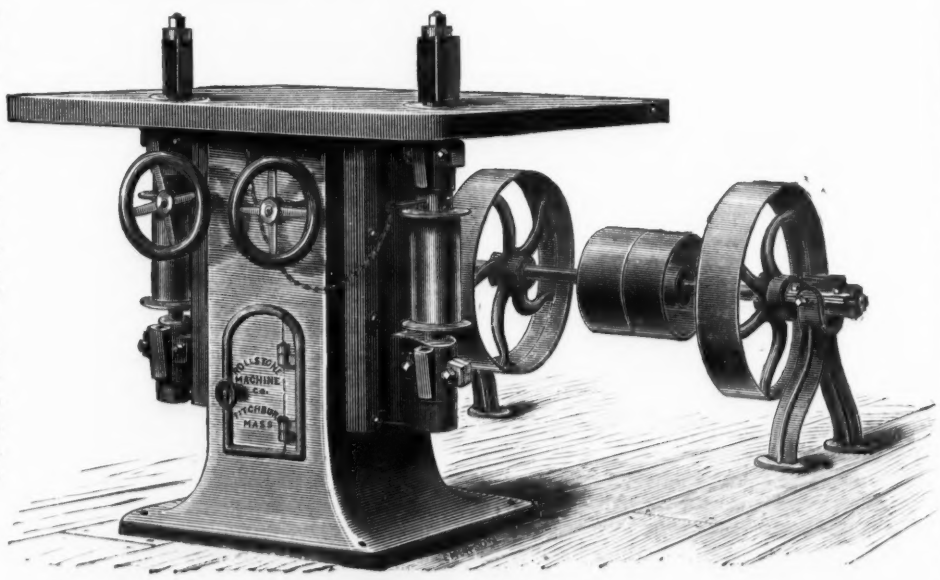
"*Do*, it will just save me $1,000."

I said it would go at the appointed time. The piston-head was fitted on a taper, turned smaller than the body of the rod, with a nut to hold it on. I first straightened the rod. I had noticed a sheet of old boiler iron lying before the furnace. Out of this I cut two circular pieces $8\frac{1}{2}''$ in diameter (the cylinder was $9''$x$18''$), with a hole in the center of each; filed these holes to fit the rod closely, one to go against the shoulder, the other for the nut to turn against; next fitted two pieces of oak $1\frac{1}{2}''$ thick, of a diameter to fit the cylinder with holes to fit the rod, being careful that they were in the center and fitted tight. I put three $\frac{1}{2}''$ bolts through plates and wood to clamp them firmly. Next, I cut a groove in the center of the wood $1\frac{1}{2}''$x$1\frac{1}{2}''$ to receive hemp, put it on my rod, screwed up the nut and had as good a head as any one *wood* want for a short time. Another piece of oak $1''$ thick did duty for a cylinder-head, and was ready to "run" an hour before noon. Of course all hands were pleased when the engine moved off nicely and did its work well. But I reckon Mr. Owner must had some communication with Prof. Sweet, for his remarks proved it: "Pshaw! we could have done that ourselves."

HARRY HART.

New Wood-Working Tools.

The power mortising machine which we illustrate, has a frame cast in one piece. It is provided with two tables, one of which is plain and the other compound; the work



DOUBLE-SPINDLE SHAPING MACHINE.

being clamped upon the table any part of it can be brought under the chisel. The table can be set at any desired angle, and can be lowered to take 15 inches under the chisel by means of the hand-wheel and screw. The boring attachment is on the side of machine, and can be detached when not required for use.

The double spindle-shaping machine is designed for shaping straight and irregular forms for carriage, wagon, car, furniture, and other work. The frame is cast in one piece. The column is provided with a door, the interior forming a receptacle for small tools.

The spindle boxes are cast with the slides, the latter being gibbed to the bars and adjustable vertically by the hand-wheel shown at the front of machine.

The table is of either iron or wood as desired. It is fitted with concentric rings to suit various sizes of heads and cutters. Spindles will take cutters up to four inches in length. The manufacturers are the Rollstone Machine Company, Fitchburg, Mass.

Learning to Draw.

BY JAMES F. HOBART.

HOW TO LEARN—BUYING TOOLS—STUDYING AT HOME—A HOME CLASS—PRELIMINARY PRACTICE—PROJECTION.

The question is often asked by young mechanics, "How can I learn to draw?" or "How can I obtain a knowledge of practical drafting; being so situated that I cannot get the benefit of instruction from a teacher?"

There is one method of studying drafting, which is within the reach of all, no matter how or where situated, and to such would-be students these remarks are directed:

Buy a few drawing tools, or make them; also a book treating of drafting, and study at home during the odd moments and spare hours. A very good idea of drafting may be gained at home, and no one need feel diffident about saying "I learned drawing by the kitchen fire."

If there are a number of person who desire to study let them club together and start a drawing school of their own. Let them acquire a book treating upon the subject; provide themselves with a room where they can work undisturbed, and begin the work at the beginning by learning to draw lines and curves; to erect perpendiculars; to lay off angles, and to construct squares, triangles, and polygons. Let them begin at the very beginning, and not try to "know a thing before they learn it." Become accustomed to handling the tools, find their "weak points," and also their own, and study to favor the one and correct the other.

By the time that a knowledge of the instruments has been acquired, they will be able to perform most of the problems pertaining to the art of drafting; that is, they can produce lines from, to, and in any given position. They can construct with compasses and rule about any desired figure or angle, and they will have learned how to make about any desired form of line. Let the next step be the use of ink. Study the art of "inking in" a drawing after it has been drawn in pencil. Also learn and practice the use of different sizes of lines for center work and finish lines; and the use of red, blue and black inks in making a drawing.

After thoroughly practicing the foregoing, the student will be ready to take up projection. What has been learned is but the preliminary study of the art of machine drawing. Upon a knowledge of projection depends the whole. Let the student once thoroughly understand this important part of the matter and he need have no fear but he can represent upon paper any shape, however complicated it may be.

We will assume that the class has fairly started on its course. It appointed one member teacher pro tem, to set fourth the lessons contained in their text book. With chalk dividers and a big T square, the lesson is drawn upon a black-board for the remainder of the class to copy.

In this manner they become accustomed to working from sight and dictation, and a comprehensive idea of various subjects is acquired.

Of course many perplexing points will come up in the course of time. It will be surprising if the teacher does not get stuck, and is not able to solve the knotty questions which come before him. No matter, such things are to be expected. The class must resolve themselves into a "committee of the whole" to contend with the hard or disputed questions. If they are too hard, some assistance must be sought outside. Somebody will surely be accessible who will answer questions relating to drafting technicalities.

To many who wish to learn to draw, yet are unacquainted even with what is needed to begin work with, the undertaking may well seem formidable, yet, with a good stock of patience and a fair stock of *brains*, success can surely be attained.

Let the student purchase one pair of good compasses with pencil and pen attachments. Let him pay for the same as much or more than he would pay for the whole cheap set, and he will find himself amply provided with tools for present use.

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NEW YORK, MARCH 20, 1886.

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One Way to Improve Steam-engine Economy.

Improvement in the steam-engine for the past fifty years has consisted mainly in putting into practice what was already known to be desirable. In this, as in most other affairs, it was found to be one thing to know what was desirable, and another thing to accomplish it. Better plans of construction have rendered the use of high steam-pressure and high piston-speed more common, and these, with better workmanship and careful attention to details, have brought about better economy. Considered as a machine, recent improvements in the steam-engine have been important. Undoubtedly there is room for further improvements in these directions—there is no such thing as standing still—but the ground has been so well covered that nothing radical is to be expected, except it come from the establishment of new and important facts in the science of steam engineering, and from a direction not now very obvious. Improvements in tools and machinery for doing good work cheaply have had much to do with improving the construction of the steam-engine, not only by affording the means for doing so, but frequently by pointing out the direction for improvement. Aside from this, the introduction of better instruments for, and better methods of, measuring effect has been important.

But steam engineering embraces not only the designing and construction of steam-engines and boilers, but their management, as well, and here there is room for general progress in the direction of better economy. If not a new field, it is one that has not been as extensively cultivated as it ought to be. Users of steam-engines are, owing to long and persistent effort, fairly well educated in the economy of paying for good design and construction; but they do not to the same extent appreciate the value of good management. Sometimes they are, so it seems, of the opinion that there is not much in the way of economy in the every-day management of a steam plant, except what is comprised in stopping and starting, and in keeping up the motion for the required number of hours; their interest ceases after hiring an engineer just competent for this duty, or employing a competent engineer who finds no co-operation from any quarter, in his efforts to reduce expenses in his department. In hundreds of instances a false system of economy is applied to the motive plant, one that would not be tolerated in any other department of the works. Money expended in needed engine-room appliances is looked upon as sunk—thrown away—instead of as invested where it will yield good returns. It is all right so far as paying for a good engine is concerned; but here all interest ceases; it ought to take care of *itself*. How many owners of steam-engines believe that a steam-engine indicator is one of the necessary appliances of the engine-room, or that an engineer should be provided with convenient appliances for weighing coal and water supplied to the boiler? Some, to be sure, but a remarkably small percentage of the whole number.

A good engineer is not particularly different from any other good workman. If he finds that no one has an interest in what he is trying to do to reduce running expenses; that such appliances as he needs for economical operation, and for determining results, are refused or furnished grudgingly, with no interest manifested in their use, he will be reasonably certain to form easy-going, careless *and costly* habits. This is not a part of an engineer, it is a part of human nature. A contrary course from that indicated will as surely yield contrary results. It may be set down as a fact that a thoroughly competent engineer is never satisfied when power is costing more than it ought to cost. Keeping expenses low is part of his stock in trade. It represents, or ought to, a large part of what he sells; but he is too often obliged to put up with conditions that, if permitted, he could remedy.

If owners of steam-engines would look with some degree of interest to authentic records of fairly conducted tests, and then compare these with their own expenses for power, it is probable that in many instances they would find something startling in the difference.

Further investigation would sometimes reveal incompetence in the engine-room; but, perhaps, oftener the cause would be found in their own refusal to second the efforts of a competent engineer. Either would be about equally fatal to good economy. Not that the every-day economy of a motive plant is likely to equal that of a closely conducted test of the same engines and boilers, but the latter shows the possibility that may be closely approximated. To insure that the best attainable results are being obtained, it is absolutely essential that comparisons be readily made. This has been provided for by modern science and common sense, and to fail to make use of what is thus provided is to put to one side one of the best known means of securing economy. When, as is often the case, the results of actual practice are about fifty per cent. those of a fairly conducted test there is good reason to look for something wrong. But means of easily making comparisons must be provided if any advantage is to be taken of the experience of others. Economy in motive power is made up of small things, and observations must be specific as well as general.

When the operation of the motive plant gets outrageously bad, an expert is called in to straighten matters out. But this is not until after a good deal of waste. When it is done, the cost of discovering the trouble, to say nothing of the cost of the remedy, is likely to be more than that of previously supplying the engineer with such things as he required, and by reasonable encouragement making an expert of him, ready to suggest preventives instead of costly remedies.

The interests of manufacturers call for economical motive power, and a very apparent direction for improvement in this respect is through the engine-room. We hear a great deal of the need of skilled workmen in other branches, and but little of the need of skilled engineers, yet economy in manufacture must begin in the engine-room. Engineers must to a greater extent than most other workmen educate themselves; they ought to be afforded every reasonable opportunity for doing so. Not out of any sentiment, but because it is policy to do so. Whenever this is done we have never heard the complaint that it did not pay. The first requisite is a good engineer. None other is cheap at any price. The second is to stand by him in his efforts to keep whatever of cost, *and loss* may properly be charged against the power department low. If no mistake has been made in the man the result will be satisfactory. Such a plan universally followed would soon produce a body of highly skilled engineers with a total saving to the manufacturing interests of the country beyond any estimate likely to be made. We say *loss* as well as *cost*, because losses that must be counted in the general business, and that outweigh the entire cost of the motive plant, are not infrequently directly traceable to engine-room management. It is unnecessary to discuss this; it is well understood, but seldom properly considered.

The amendment of Senator Plumb to the Inter-State Commerce bill ought to become part of the law of the land. It prohibits railroads from issuing free passes to members of Congress, Government officials or their families, and makes it unlawful for officials to apply for passes, or to pay less than regular fare for traveling by rail. If the Government does not pay members of Congress a sufficient salary to relieve them of the necessity of becoming public deadheads, they ought to look for a better job. The impression is that the receiving of such favors from railroads, by those who have opportunities to legislate in their favor, means a return that comes out of the taxpayer's pocket.

The Brotherhood of Locomotive Firemen numbers 15,000 members, yet so quiet is their work that but few outside railroad circles hear much about it. Its object is mainly the improvement of its members, in which direction it is doing excellent work. During the past twelve years nearly a half-million dollars have been paid its members as benefits.

Territorial Limits of Natural Gas.

Among later developments of the natural gas boom are published statements that "paying" wells have been discovered, and are being "worked" in a number of towns as far removed from the original centers of production as Central and Northwestern Ohio. We believe, also, that equally confident claims are made for some Southern towns. If the published statements of the new "finds" are well based, it would seem that the territorial limits of the natural gas "fields" are not yet very well defined, or with present knowledge of the subject capable of very close definition.

A New Railroad Brake.

It is not often that a really great invention is born of what a lawyer would call "malice aforethought." A Virginia inventor is living proof that such an exception may occur. In a local paper he publishes an advertisement highly laudatory of an automatic railroad brake, which he has "discovered" and patented, but omits to publish any explanation of its construction or the principle on which it acts.

In the published card, he says he was standing at the "station" as a freight train went by, and noticed that the brakeman tried to stop the train, but found some difficulty in doing so immediately.

The future inventor thereupon remarked to some gentlemen present that he proposed to get up an automatic brake, which would stop the train without "all that trouble." He now announces that, after four years of hard study and almost sleepless nights, he has accomplished his object, and closes by expressing his hope that railroad managers will examine his "patent right" at once, that they may "relieve the poor, worn-out, rest-broken and frozen brakemen," his "greatest desire" being to see them released from their exposure and sufferings. His next greatest is not stated, but it is to be hoped that railroad managers will be willing to gratify it, if it is shown to their mechanical satisfaction that our Virginia friend's claim for his invention are as well based as he affirms. We think, however, that most railroad managers will be apt to require substantial proof of its superior merits before investing largely.

The Automatic Car-Coupler Movement.

Just at this time the evidences of activity—on paper at least—among the "manufacturers" and promoters of rival automatic car-couplers are numerous and interesting. Companies, firms and individuals, apparently in business for no other purpose, are putting forward the claims of their respective devices, in a confident way, that to the average railroad official must be just a little confusing, to say the least.

It would be interesting to know how much of the current activity in this direction represents actual sales, and how much is to be attributed merely to the hope of some time getting the respective devices adopted. One thing is certain, that anything like the substantial introduction of new couplers upon the general railroad mileage of the country will mean a good deal of new business for somebody.

The car-coupler question is not as simple a problem as, on its face, it seems to be to the majority of the sanguine workers in that field. In addition to the requirements ordinarily demanded of new mechanical devices as essential to their general introduction, the automatic car-coupler of the future (and there may not be more than one) must, of necessity, be adapted to work readily in connection with the hand-couplers now in use, and with other automatic couplers, so far as others get into use. Cars equipped with automatic couplers must be adapted to run on any railroad in the country. It will not be easy to induce all the roads to simultaneously throw away all the old and adopt a new style of coupler, though if the railroads could and would unite upon a single device, and arrange for its general introduction, the brightest dreams of

at least one inventor would doubtless be realized.

Possibly, instead of depending upon the uncertain and conflicting promptings of State legislatures and railroad commissions, the power of Congress over inter-State commerce may some day be invoked to require all freight cars passing from one State to another, after a given date, to be equipped with automatic couplers.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(112) J. H., Winona, Minn., asks: What weight or resistance will six ¾" bolts withstand, ten threads to the inch, nut ¾" in thickness, well made of Norway iron? *A.*—We should say such bolts could be depended upon to hold from 2,000 to 3,000 lbs. each, according to the conditions under which they were used.

(113) G. F. L., Willimantic, Conn., asks: In which way will a twist drill best clear itself of chips—when it is running in the work, or when the work is running on the drill? *A.*—Probably it will be when the drill is running in the work, as the chips have then a better chance to work out of the hole, as they are alternately carried over and fall under the drill.

(114) H. V., Greenpoint, N. Y., writes: 1. I would like a permit to run a small steam yacht. Where should I apply for it? *A.*—At the inspector's office, in the New York Post-office. 2. How much power will I get from an engine 2½"x3", at 60 lbs. boiler pressure? *A.*—Probably you may get nearly one horse-power. 3. Is a screw 14" diameter and 20" pitch too large? *A.*—About right.

(115) A. E. H., Bradford, Conn., asks: how to pulverize resin economically, in large quantity? *A.*—A method used in some large paper mills, is to use a common corn-cracker, such as in use in some country grist-mills for breaking up corn in the ear. A machine of this description can be so adjusted (like a coffee mill) that resin can be ground to any desired degree of fineness.

(116) Laurel, Ind., asks: 1. What is your opinion of suspending the rear end of a tubular boiler by means of a strap passing entirely around it, instead of by hooks riveted on? *A.*—We can see no objections, except that the expansion and contraction of the long strap will bring about a little more up-and-down motion to that end of the boiler.

How many 4" tubes should there be in a 42" shell? *A.*—Barr gives the number of 4" tubes for a 42" shell as 25.

(117) E. D. asks: 1. What is the method of computing the specific volume of steam at any given pressure? *A.*—We cannot give you a satisfactory rule. You will find this matter discussed in Steam Engineering, by Nystrom. You will find in any work on steam engineering tables that will give you the desired information. 2. How can I compute the horse-power of a compound engine without the use of an indicator? *A.*—The work done by a compound engine will generally be a little less than what would be done in the low pressure cylinder alone, working with the same ratio of expansion.

(118) H. P. A., Brooklyn, N. Y., asks: Can you give me any information respecting the methods of coating the bottom of ships with concrete? I believe it is done for the purpose of protecting the rivet heads from injury by loose articles rolling about, and also as a water proof covering. *A.*—It is customary to cement the bottom of vessels *inside* to the upper turn of the bilge, in order to protect both the rivets, plates and angle irons from the action of the bilge-water, which may lie upon them. Portland cement and sand in equal parts are used. In applying it water lodgements should be well filled, and limber ways smoothly rounded.

(119) Subscriber, Leicester, Mass., writes: I have a steam heater connected with the boiler of a steam fire engine, for the purpose of keeping the water hot in the fire engine boiler. The heater and boiler are connected at the bottom by a ½ inch steam pipe. At the top of the heater, a ½ inch steam pipe also leaves the heater, entering the fire engine boiler just below the water line, which is on a level in both heater and boiler. The average pressure is five pounds. What is the reason that the water leaves the heater and fills the fire engine boiler nearly full? What is the remedy for this? *A.*—As the connection from the steam space in the heater enters the fire engine boiler below the water line, there is virtually no connection between steam in boiler and steam in heater; consequently, when the steam (which is confined in the fire engine boiler) condenses, it forms a partial vacuum in the boiler, the water below is forced up by the steam pressure in heater to fill the vacuum. The water will continue to rise until it fills the boiler, or reaches the limit of perfect condensation, owing to the presence of air in the boiler. The proper remedy would be to connect with boiler above the water line.

(120) A. H., Rockdale, Ind., asks: What is the power of my engine? The cylinder is 12"×18"; 100 revolutions; steam pressure, 80 pounds. the steam ports are 1"×10"; exhaust port, 2"×10"; length of valve, 7⅛"; travel, 2¾"; the steam pipe is 3" diameter, 20' long, with three elbows; exhaust pipe, 4" diameter, three elbows. *A.*—So far as we can judge from your description, we should say the engine should develop forty horse-power under conditions named, with a fair margin for governing. Steam pipe (with three elbows) should be 3½" diameter. The best way to determine what your engine is doing, and its faults, is to apply the indicator.

(121) C. I. F., Camden, N. J., writes: My engine runs 260 revolutions per minute; the pulley is 24" in diameter: I want to put a machine in the factory to run 100 revolutions; what pulleys are required. *A.*—To decrease the speed one-half, belt from the 24" pulley to a pulley of double the size, or 48". If this would be uncomfortably large, you may put in a countershaft, belting to it upon a 24" pulley, then from a 12" pulley upon the same shaft, to 24" pulley upon the machine. 2. Which is the best, an upright or a horizontal engine? *A.*—That will depend upon many circumstances; one may be the best for one purpose, the other for another.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Power measured.—F. Van Winkle, 22 Cortlandt, N. Y.

Alt, Mechanical Engraver on Wood, 318 B'way., NY

T. M. Parker, Steel Stamps, Stencils, Hartford, Ct.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 48 Beekman st., N. Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Tools, Hardware and other specialties made under contract. American Machine Co., Philadelphia, Pa.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John st., N. Y.

Patent Attorney and Expert. Machine designs and details. Wm. H. Weightman, 82 Astor House, NY

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

10,000 names of Manufacturers in N. Y. and N. J. Steam Users' Directory (in press); send for circular. J. N. Mills Pub. Co., 30 Vesey st., New York.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Feb. 13, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co., Collinsville, Conn

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-taught," $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Bound Volumes of the AMERICAN MACHINIST for the years 1880, 1881, 1882, 1883, 1884 and 1885. These volumes are strongly bound in cloth, and will wear well. Price $3.50 each; express charges additional. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

"Locomotive Engine Running and Management." By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air-brake explained by aid of engravings. Price, $2. For sale by Angus Sinclair, 175 Dearborn street, Chicago, Ill.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo. edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES

A 10 per cent. increase of wages is announced at Farwell's Mills, Lisbon, Me.

New shops will probably soon be built by the Nashville (Tenn.), Engine and Iron Works.

The Springville Manufacturing Company of Rockville, Conn., propose to build a large brick mill this spring.

The Pratt and Whitney Company, Hartford, Ct., are running increased hours in several of their departments.

The Cole Manufacturing Company at Lake Village, N. H., will soon erect a new shop 50x80 feet, and three stories high.

The Paris Manufacturing Company, Paris Me., will immediately rebuild their factory, which was recently destroyed by fire.

The Pultz & Walkley Company, Plantsville, Ct., is putting up shaftings and otherwise preparing its factory for new machinery.

Thompson & Holmes, Rockville, Ct., have sold their chuck works to the Cushman Chuck Works, of Hartford. The principal work in the shop now will be the making of stationary engines.

The Malinckrodt Chemical Company, North st., Louis, Mo., will build an extensive addition to their factory, and also expect to make other important additions to buildings and machinery.

The employes of the Warren Foundry and Machine Co., Phillipsburgh, N. J., have been notified that their wages will be advanced 15 per cent. on March 15. The establishment employs about 400 men.

Brehmer Bros., of Philadelphia, have begun importing Brehmer's thread book-sewing machines from Leipsic, Germany, and propose to manufacture the machines in this country as soon as the demand warrants.

The Lees Manufacturing Company, Westport, cotton goods, are running their works until 10 o'clock every evening, in order to keep pace with the steady stream of orders, and the proprietors are contemplating putting in an extra set of hands, so as to run 24 hours per day.

Notices have been posted in the Shetucket Company's mills, Norwich, Ct., that on March 1, an additional 5 per cent. will be added to the 5 per cent. increase of pay lately made. The Ponemah Cotton Mills, at Taftville, Ct., will advance the wages of their 1,500 employes 10 per cent. on March 1, and reduce the hours of labor from sixty-six to sixty per week.

The National Pipe Bending Co., of New Haven, report that the spring trade is opening up well and orders are coming in rapidly. Among recent sales of the National Feed Water Heater are: Three of 50 horse-power each, two of 60 horse-power, two of 80 horse-power, two of 100 horse-power, one of 150 horse-power, one of 200 horse-power, one of 300 horse-power, one of 400 horse-power and two of 800 horse-power.

The members of the Western Canned Goods Association recently visited in a body the extensive branch works of Norton Bros. at Maywood, Ill., and expressed themselves as pleased with the working of their can-making machinery plant, as illustrated in our issue of July 14, 1883. The members of the association announce that they intend to increase their "pack" 30 per cent. during the canning season.

The Champion Card and Glazed Paper Company will build extensive works at East Pepperell, Mass., during the coming spring, This company at present occupies extensive quarters near the paper mills of S. D. Warren & Co., but are forced to remove and build larger works to accommodate their increased business. They will erect a main building 400x90 feet, two stories high, and also annex other necessary buildings, such as boiler and engine house, box factory, stock house, etc.

The Yale and Towne Manufacturing Co., of Standford, Conn., are building for Carnegie Bros., Pittsburgh, two five-ton "locomotive," or self-propelling cranes, having a radius of 18 feet, with track gauge of seven feet, for use in handling steel blooms. The machines have capacity for hoisting and rotating and traveling on the track under their own steam. Speed of travel 450 feet per minute. The manufacturers number their cranes of all kinds consecutively, the last turned out being No. 391. Those under way will increase the number to 400.

Thomas H. Dallett & Co., of Philadelphia, have taken an interest in the business of Matthew Fifield, manufacturer of dental instruments, and the Fifield Manufacturing Company has been organized to prosecute the business, the office and works being located in the same building with Thomas H. Dallett & Co. The latter firm has fitted up the three story building, corner 13th and Buttonwood sts., Philadelphia, and are putting in a number of new tools for the manufacture of drills, etc. The building is 40x70 ft., the first story being devoted to heavy tools, the second to light tools, tool room and office, and the third to pattern shop and drawing room.

The New York Supply Company, limited, 50 and 52 John street, New York, is the name of an incorporated company just formed to succeed W. C. Duyckinck, and sell railway, machinists', engineers', brewers', steamship and miners' supplies, and plumbers', gas and steam-fitters' materials. We are informed that $31,000 capital is paid in. The officers are M. H. Daniels, President; Levi Best, Vice-President; Robt. G. Weeks, Treasurer and General Manager; C. Homer Bush, Secretary; J. H. Forey, Sales Manager.

The Shephard Manufacturing Company, Naugatuck, Ct., says the *Manufacturer's Gazette*, will build a factory on the grounds of the old Naugatuck Machine Company at Union City. Joseph Church & Co., Tiverton, R. I., are building a large addition to their oil works for an engine and boiler-room and machine shop. The building of a paper mill is being talked up at Seneca Falls, N. Y., and Rumsey & Co., proprietors of the pump and fire-engine works there, are interested in the project. The United States Steam Packing Company, Medfield, is building an addition to its factory.

Keene & Brown, whose chair factory at North Turner, Me., was recently destroyed by fire, have a force of 20 men busily engaged rebuilding, and hope to start up work in the factory during next month. E. I. Abbott is making improvements at his mill in Franklin Plantation, Me., and contemplates putting in a new water-wheel, also machinery for cutting spool strips. Mayo & Son, Foxcroft, Me., are to enlarge the capacity of their woolen mills by the addition of a number of cards and mules. On account of heavy demand for their goods these mills have of late been running evenings.—*Industrial Journal.*

The Assabet Manufacturing Company, woolen goods manufacturers in Maynard, Mass., who employ about 1,000 operatives, have given notice that wages will be advanced ten per cent. on March 1. The wages of the employes of the Dwight Manufacturing Company at Chicopee, will be raised about March 1. The Blackstone, Mass., cotton mills have given notice that an advance in pay is contemplated March 1. Wages in the Victor knitting mill at Cohoes N. Y., will be increased 10 per cent. on and after March 1. The Victor is now running night and day to fill orders for camel's and white wool goods.—*Boston Commercial Bulletin.*

Morse, Williams & Co., 411 Cherry street, Philadelphia, who recently bought from E. W. Bliss the patterns, drawings, and stock complete of the Waldron rotary engine (first illustrated in our July 30, 1881, issue), have made a number of improvements in the engine, and will build as a hoisting engine, with special reference to its use in connection with their elevators. In New York city especially, the practice of running elevators by direct steam from the steam company's pipes, is becoming quite general. It is also proposed to build the improved Waldron for use as a fire pump in mills and factories; also as a boat engine, or it can be mounted and used as a regular fire engine.

The demand for iron buildings for manufacturing purposes, says the Boston *Commercial Bulletin*, shows a decided increase this year over last. Wm. B. Scaife & Sons of Pittsburgh, report under way one iron mill building for W. D. Wood & Co., at McKeesport. 112 feet span by 185 feet long; three iron buildings for the Braddock Wire Company, 91x112, 73x80 and 48x54 feet respectively; one iron building for the Sunset Carbon Company, of Butler, Pa., 56x130 feet, for the manufacture of carbon black, and still another one, 110x140 feet, to be used as a sheet steel mill by Jennings, Beale & Co., at Apollo, Pa. J. W. Moore, the coke operator of Pittsburgh, is staking off ground for 350 ovens, to be built as soon as possible, adjoining his present works.

The Wiley & Russel Manufacturing Co., of Greenfield, Mass., will soon erect an addition, 25x35 feet, two stories high. John Kinsman, of Salem, Mass., will erect a brick block, three stories high, to be occupied as a shoe factory by Rich & Woodbury. W. H. Weedon, Newton, N. C., will start a spoke and handle factory. Cost, $7,500. The Gordon & Maxwell Pump Co., of Hamilton, Ohio, contemplate extensive additions and improvements to their pump works. The Co-operative Furniture Manufacturing Company, of Williamsport, Pa., propose to erect a building in Canton Borough, Pa., 48x80 feet, two stories high, with engine-house, dry-kiln and finishing-shop. Will put in boiler, engine and machinery sufficient to employ from twenty-five to fifty men. J. B. Loucks, of Scottdale, Pa., will erect a large nail mill: 100 hands will be employed. Nothing yet contracted for. The Keystone Portable Steam Drilling Company, of Fallston, Pa., will enlarge and greatly improve its works. Additional machinery will be needed. It is rumored that the Chicago, Burlington and Quincy Railroad Company—General Superintendent, T. E. Calvert, Omaha, Neb.—will extend their road to Leavenworth, Kas., for the purpose of locating shops. W. L. Scott, of Erie, Pennsylvania, will in the near future erect a rolling mill at Industry, Pennsylvania. The Berlin Bridge Company, of New York, intend, it is rumored, to build a large mill at Binghamton. The New York, Central Sleeping Car Company, of New York will erect in Buffalo, N. Y., a large shop, to cost about $200,000. Six hundred hands will be employed. The Cole Manufacturing Company will erect, at Lake Village, N. H., a new building, 50x81 feet in size, and three stories high. William Stirling, of Don, Ohio, will erect a tool factory in the spring.—*New Enterprises.*

Machinists' Supplies and Iron.

NEW YORK, March, 4, 1886.

The market has been steady and quiet.

Iron—In American pig the production is closely absorbed by contract deliveries. No. 1 X, Foundry, at tide water, $18.00 to $18.50; Standard, Lehigh and North River, $17.00 to $17.50; Grey Forge $16.00 to $17.00.

Scotch Pig—Dull. Coltness, $20.50 to $21.00; Glengarnock, $20.50; Gartsherrie, $20.00 to $20.50; Summerlee, $21.00.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

A mechanical draftsman wants outdoor employment in connection with drawing. Address, Dirigo, AM. MACHINIST.

Wanted—Boiler shop forman desires situation; best of references as to character and ability. Address, W. B., AM. MACHINIST.

Wanted—A first-class pattern-maker and lathe hand. Address, McEwen Bros. & Co., Lim., Ridgway, Elk Co., Pa.

Wanted—A grinder and polisher on general machinery; must be a good workman and of sober habits; steady employment and good pay guaranteed. Address, T. E. J., AM. MACHINIST.

Wanted — A first-class practical foundry foreman; one willing to undertake the castings by contract preferred; output 50 to 60 tons per week. Address, with references, Sigma, AM. MACHINIST.

Wanted—By a thoroughly competent engineer, a position to take charge of the motive power and machinery of a large establishment; is a machinist and draughtsman. Address, E. S., AM. MACHINIST.

A gentleman, for many years in the tool, machinery and supply business, desires to communicate with parties (West preferred) regarding business propositions in that line. Best of references. Address, G. B. R., box 235, Boston, Mass.

Wanted–A few first-class workmen on mathematical, electrical and philosophical instruments; good wages and steady work to competent men. Address, with reference, James W. Queen & Co., 924 Chestnut street, Philadelphia.

Wanted—Position as supt. of machine shop and foundry; experienced in grist-mill, saw-mill, agricultural machinery, estimating on same, and doing work by improved methods; fair draftsman and practical foundryman. A1 reference address John B. McLaren, Lansing, Mich.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner has no equal. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice. Pennington & Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

C. F. Langston & Co., 222 N. 5th st., Phila., canmakers' tools, presses, dies and special machinery built, rotary cutters made and gronnd.

Wanted, good second-hand foundry plant, cupola, crane, etc. Address, with description and price, Box 1127 Corry, Pa.

Machine shop and foundry for sale in a Western city; full or half interest. S. & H., AM. MACHINIST.

Patent or new Process; capital can be found for a practical and sound patent or new process. Address, with particulars, New Process, care of Thos. Veasey & Co., engineers, Finsbury Chambers, 78 Finsbury pavement, London, E. C., England.

Wanted. a good business man, with $10,000 to $15,000, to invest in and take active management of a lucrative manufacturing business situated in the South. For further information, address Box 3, AM. MACHINIST.

Patentee of a new positive motion four-valve gear for automatic engines wishes to arrange with a party who is in position to manufacture and put it on the market; has been tested. Address, Bucks, AM. MACHINIST.

For Sale—Shafting lathe, 28" swing, takes 20' between centers; treble-geared; 5 speeds on cone, for 2¾ belt; screw feed, but not screw cutting; also cylinder boring-bar 6" diameter, screw feed; cutter-head 9" diameter, 60' traverse. A. L. Henderer, Wilmington, Del.

Engine and Boiler—30 horse-power Buckeye engine; 42"x12' tubular boiler; all pipes and fixtures, including injector, heater and smoke-stack; the whole in good condition; in use about three years; to be replaced by larger engine, etc., of same make; can be seen in operation until Mch. 1. Address Geo. A. Barnard, 70 Astor House, New York.

WATER WORKS MACHINERY A SPECIALTY.
Cor'sp'd'ce Solicited. POND ENGINEERING CO. St. Louis Mo.

GUILD & GARRISON,
BROOKLYN, N. Y.
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
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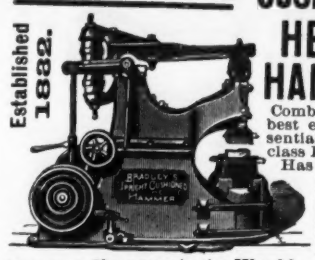

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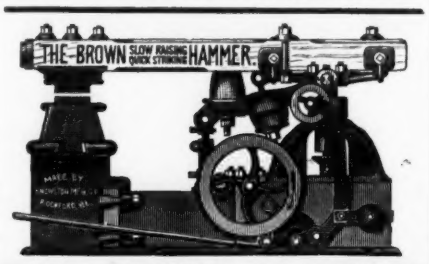

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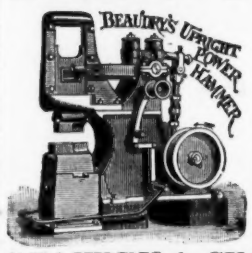

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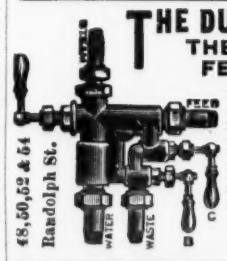

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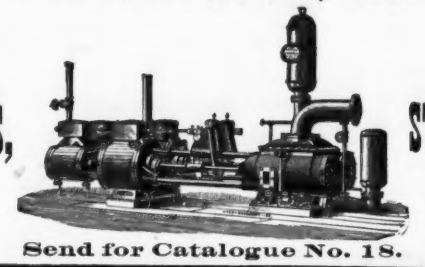

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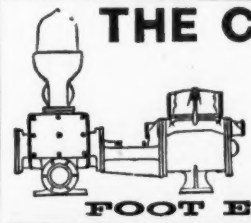

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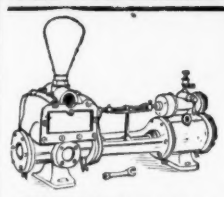

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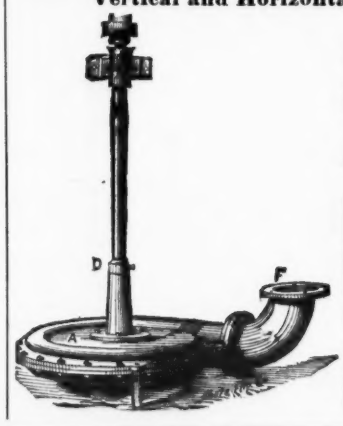

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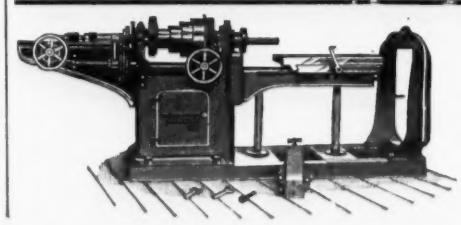

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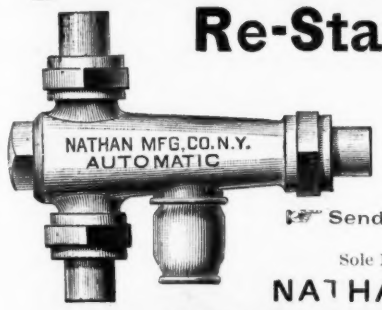

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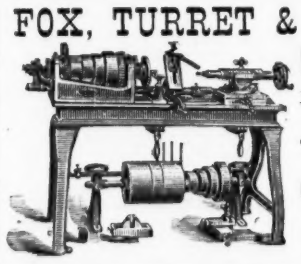

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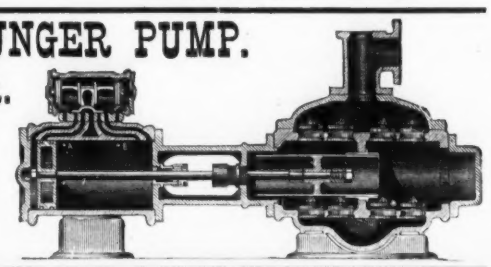

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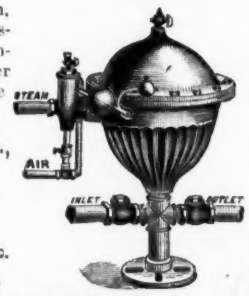

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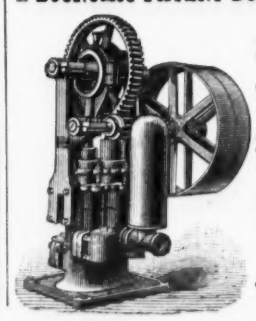

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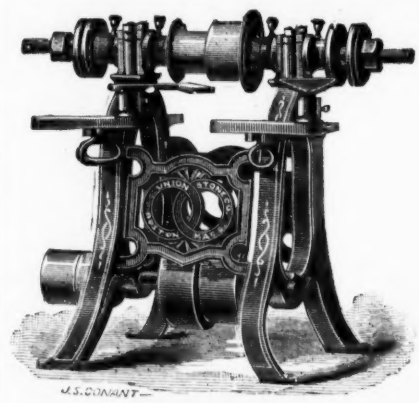

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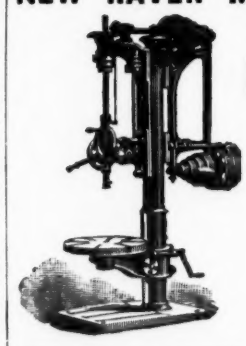

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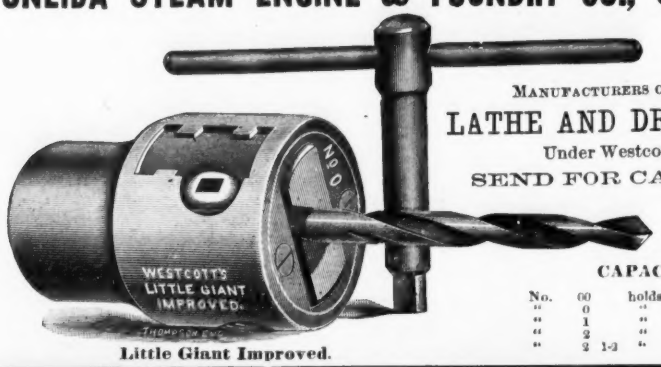

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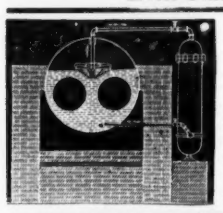

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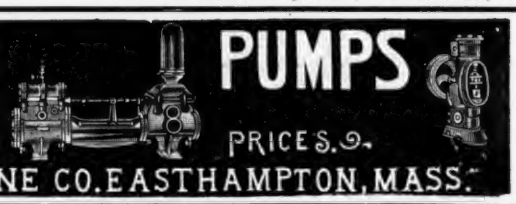

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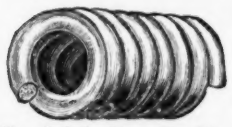

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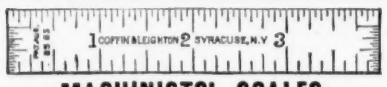

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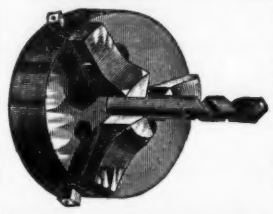

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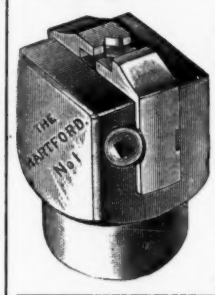

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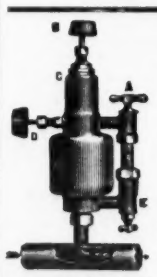

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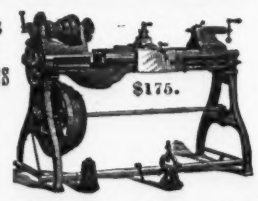

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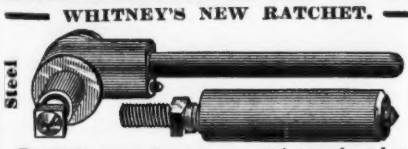

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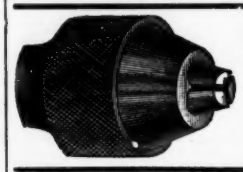

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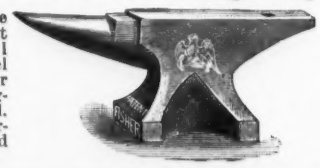

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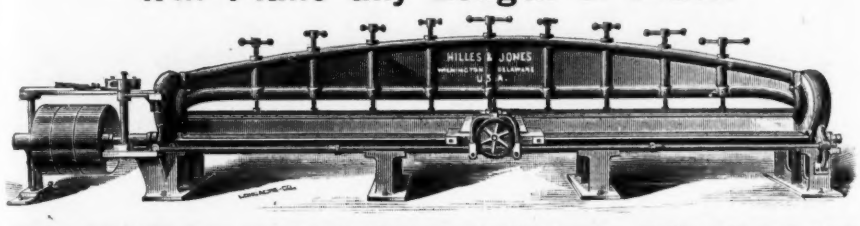

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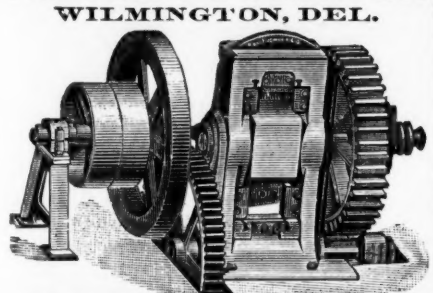

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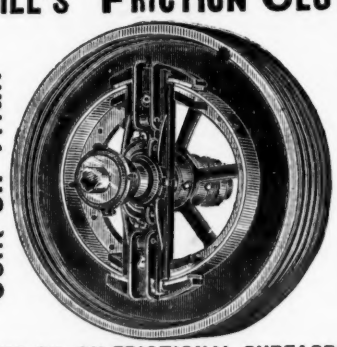

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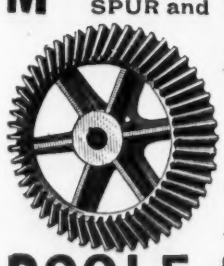

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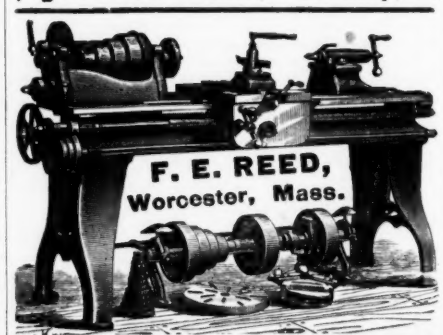

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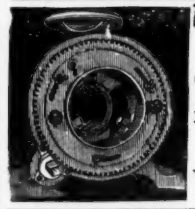

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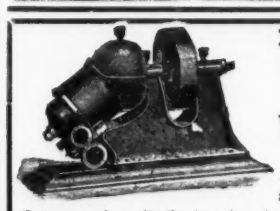

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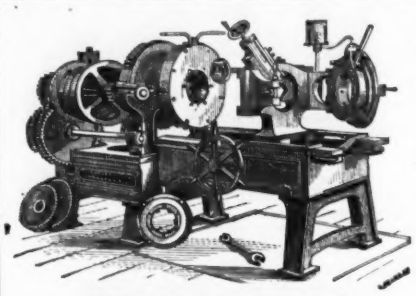

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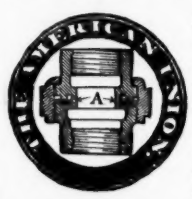

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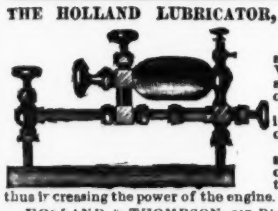

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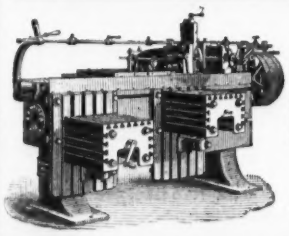

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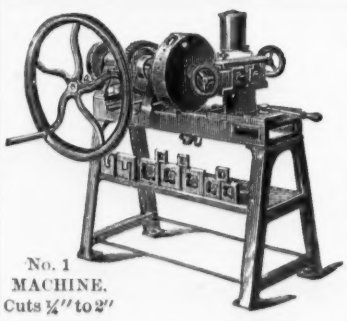

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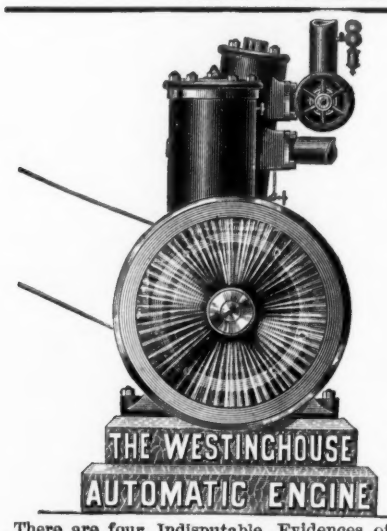

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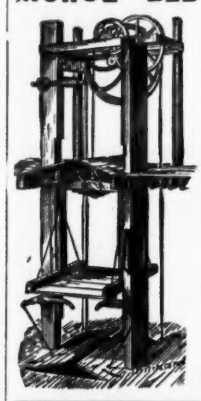

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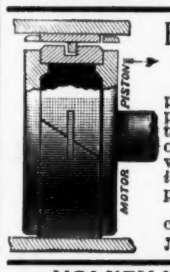

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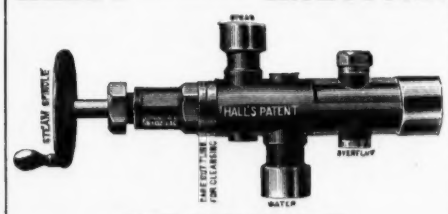

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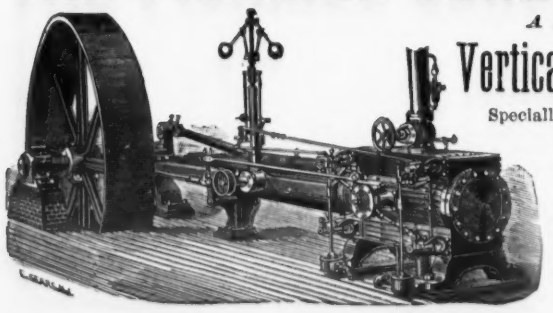

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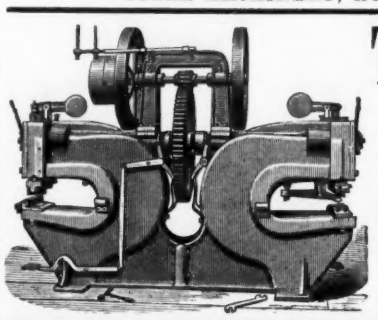

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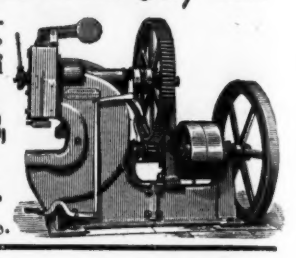

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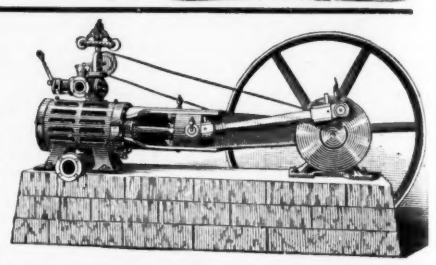

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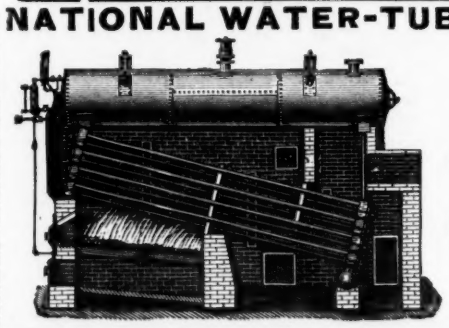

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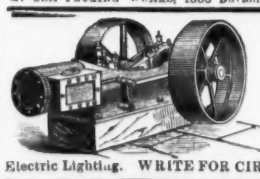

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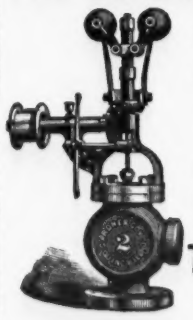

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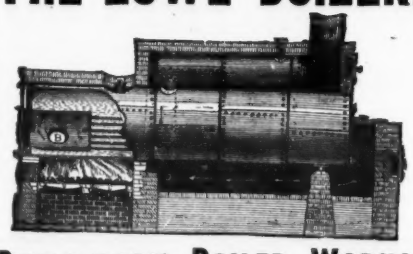

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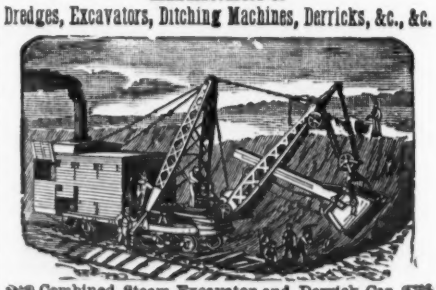

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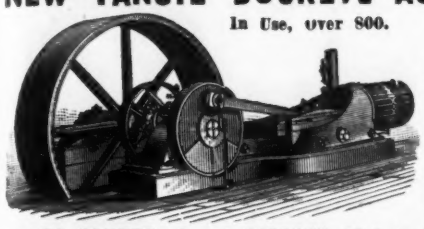

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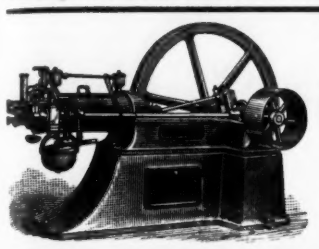

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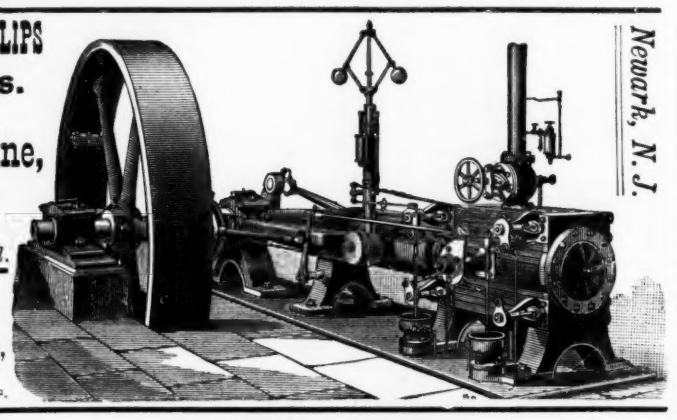

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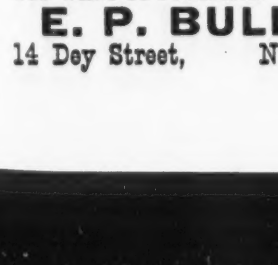

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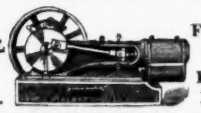

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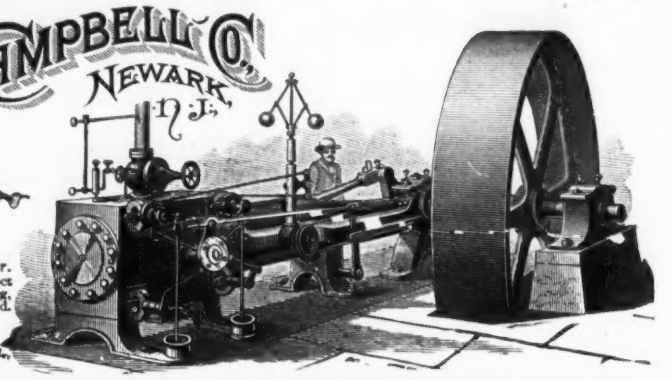

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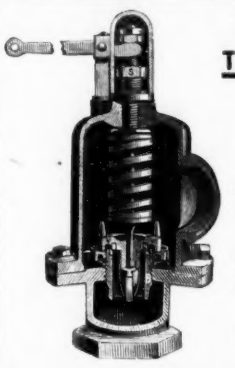

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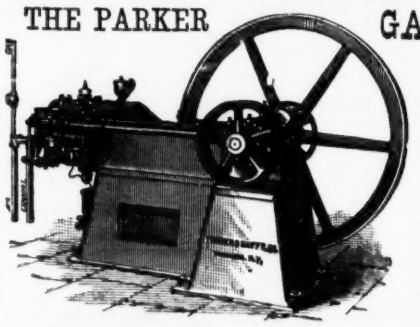

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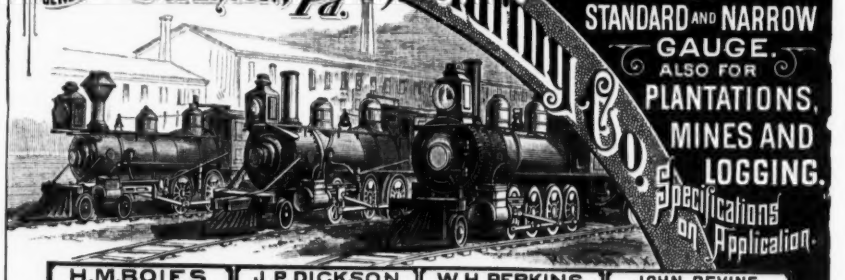

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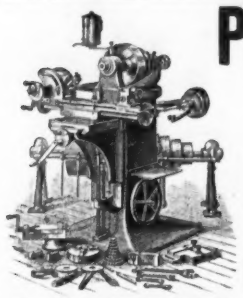

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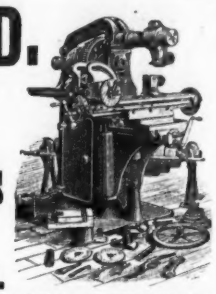

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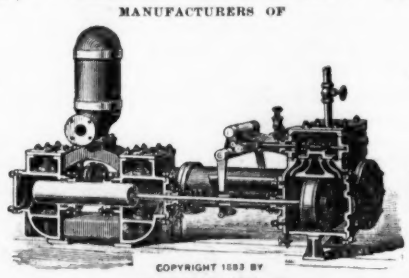

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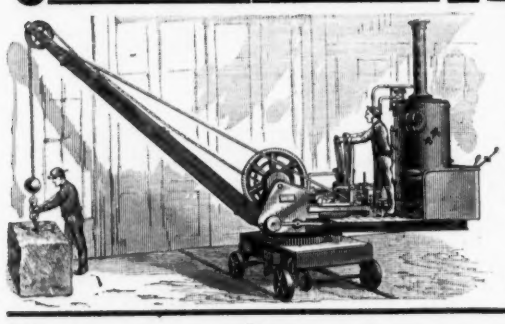

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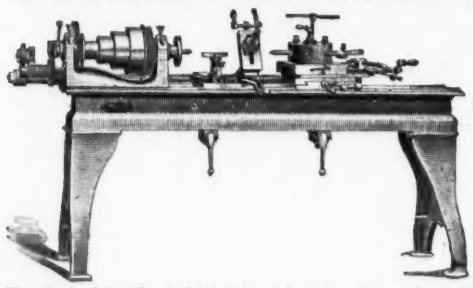

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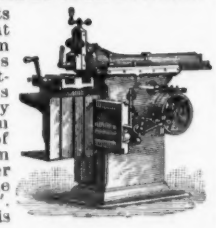

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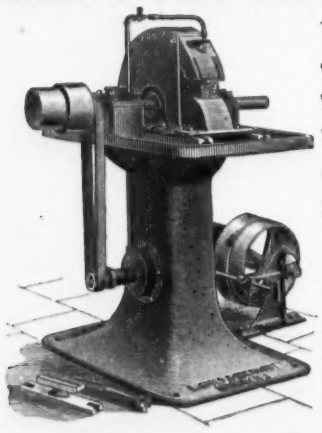

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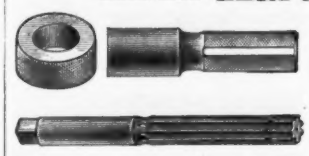

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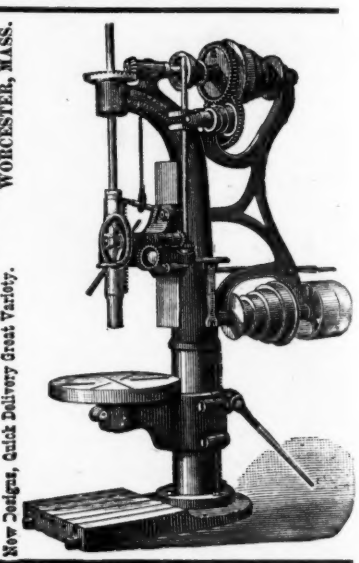

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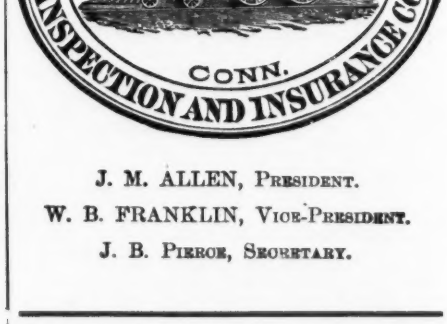

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